CIVIL ENGINEERING

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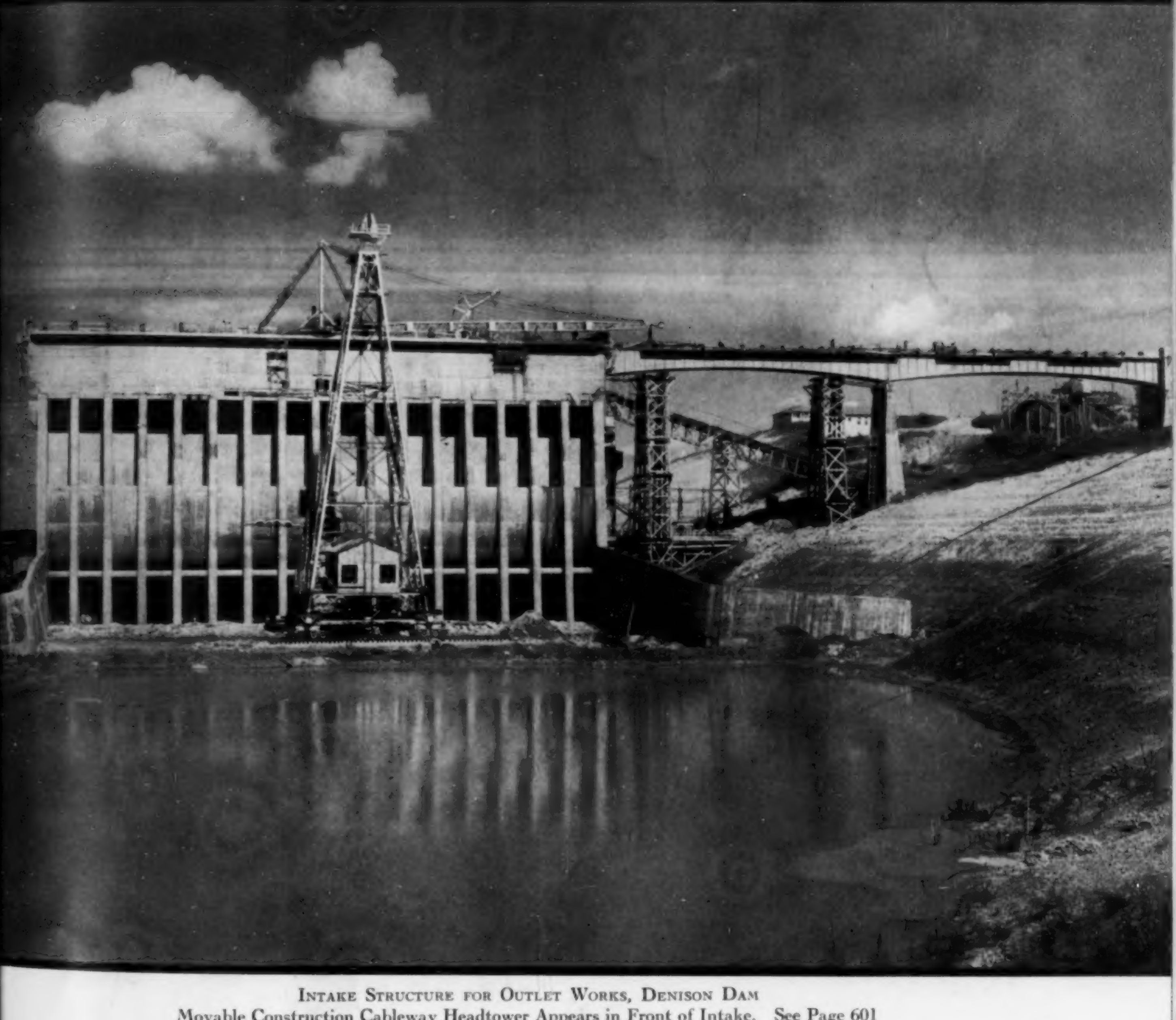

Intake Structure for Outlet Works, Denison Dam
Movable Construction Cableway Headtower Appears in Front of Intake. See Page 601

Volume 11 Number 10

OCTOBER 1941

What continent—what country—what state — what locality — what topography? These questions are important to Raymond only as they affect the transportation of the nearest personnel and equipment. For the Raymond organization, governments permitting, is prepared to undertake the successful execution of contracts for every type and size of foundation projects anywhere in the world — has been doing so for 44 years. Trained, experienced personnel and specialized equipment are strategically located for prompt dispatch to wherever they are needed. A competent Raymond representative is located so near you that you can call him in for a conference on short notice. Your 'phone call, telegram, cable or letter will receive prompt attention.

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RAYMOND

PIONEER

Theodore Dehone Judah

Among Our Writers

J. K. Finch, Renwick Professor of Civil Engineering at Columbia U., has been on the Columbia staff for 31 years and has headed the civil engineering department since 1932. In 1941 he was appointed associate dean of the faculty of engineering. He has long been interested in the broader problems of engineering education.

Fred J. Grumm has been engaged in road and highway engineering in California since 1907. Up to 1921 he worked in San Diego County, one of the first counties to engage in improved highway construction in the state. Since, he has been with the State Division of Highways and now has charge of all state highway location and design.

L. N. McClellan has been chief electrical engineer of the Bureau of Reclamation since 1924. In this period the Bureau has designed and built 23 hydro plants with a total capacity of 4,700,000 kw, among them the Boulder plant and the Grand Coulee plant, two of the world's largest.

C. L. Killgore has been on the engineering staff of the Bureau of Reclamation since 1933. He was assistant electrical engineer on inspection and test of the initial generating equipment in the Boulder power plant, and was later associate electrical engineer on the Shasta power plant.

Melvin E. Scheidt (Johns Hopkins U., B.E., '21) after a varied experience on construction work, entered the Public Works Administration in 1933. He was assistant state director in the Maryland-Delaware office, and later state director. In 1939 he joined the staff of the National Resources Planning Board and since May 1941 has been principal engineer and consultant to the Reserve on Capital Improvements and Long Range Programming Procedures.

L. J. Foster (Christian Brothers College, B.A., and M.A. and Mo. School of Mines, B.S. in E. and E.M.) entered the Bureau of Reclamation in 1904 and except for a period as captain in the Corps of Engineers, during World War I, has been there ever since. He was office engineer in the Denver office, project engineer on the Uncompahgre Project, and construction engineer on the All-American Canal System and Gila Project.

E. B. Debler has had a widely varied experience in railroad, power, and navigation work. Since 1918 he has been connected with the Bureau of Reclamation, since 1924 in charge of project planning including the preparation of reports on many single and multiple-purpose projects involving navigation, power, and flood control.

John D. Galloway (Rose Polytechnic, B.S., 1889) opened a consulting office in 1900 and for 41 years has engaged in bridge and building design, hydroelectric power plant design and construction, irrigation, and related subjects. During the World War he served for 14 months in France as a major in the Engineer Corps. An interest in the historical aspects of engineering led to the preparation of the articles on Theodore Judah.

J. T. Thompson (Johns Hopkins U., B.E., '17) after service as captain, Corps of Engineers (A.E.F.) became an instructor at Johns Hopkins and is now head of the civil engineering department. Since 1921 he has been connected with the U.S. Public Roads Administration, his duties being in the field of research.

G. M. O'Rourke (Armour Inst. of Tech.) entered the Illinois Central System in 1905. In 1906 he entered the engineering department and has had a wide experience in railroading from chainman to division engineer, district engineer, and assistant engineer maintenance of way.

J. A. Given (Iowa State, B. C., '08) has worked on location and construction for the Ozark and Cherokee Central and Muskogee Southern railroads, and on construction and maintenance for the Union Pacific and Southern Pacific Co. During the World War he was captain, major, and lieutenant colonel in the Corps of Engineers.

G. E. Textor (U.S. Military Academy, B.S., '24; Cornell U., C.E., '28) has been instructor in engineering at West Point and has filled a variety of responsible civil and military engineering assignments in this country and on foreign duty. At present he is District Engineer at Denison, Tex.

A. E. Niederhoff (U. of Ill., B.S. in C.E., '30) has designed hydraulic structures for the U.S. Army Engineers, the Aluminum Co. of America, and the Oregon Shipbuilding Corp. since graduation. His experience on navigation locks was obtained on the Illinois Waterway and on the Mississippi, Columbia, and Willamette rivers.

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

Science Versus Art in Engineering

By J. K. Finch, M. Am. Soc. C.E.

Renwick Professor of Civil Engineering, Columbia University, New York, N.Y.

It has often been remarked that, to those who stand in the midst of times and attempt to grasp their significance, the whole movement of events seems hopelessly confused and meaningless. There are countless cross-currents in the stream of life and there seems to be no pattern, or distinguishable direction, in the trends of civilization. This difficulty was expressed by our grandparents when they said that they were unable to see the woods because of the trees. It is frankly stated by modern youth, who remark, "We don't know where we're going but we're on our way." An antidotal philosophy was set forth two thousand years ago: "Sufficient unto the day is the evil thereof."

Yet the thoughtful man must inevitably attempt to appraise present and anticipate future trends. This is common practice in engineering and the method is that of extrapolation, based on the observation that the pathways of the present lead out of the past and the best guide to the future may be secured through a study of these pathways and the forces which influence their alinement. It is this method which I want to apply in considering the revolution in technique that has transformed an ancient art into what, in a large measure, is a modern science.

Engineering as an Art.~In a rough way we may say that for forty-nine of the fifty centuries of recorded history, engineering was practiced as an art. Then, beginning in the early years of the eighteenth century, but reaching its first marked development somewhat less than a century ago, say just before our Civil War, much of the detail of this ancient art was found to be based on mathematical and mechanical principles, and much of its technique was rapidly "reduced to a science."

The practice of an art, we are told, depends upon a natural, an intuitive genius for that art, a feeling and a judgment, in the case of civil engineering, primarily for structure, ripened through apprenticeship to a master and matured and enriched through experience. The almost uncanny abilities possessed by the outstanding engineering artists of the past, although clearly qualitative in character, at times approached quantitative findings in their accuracy.

Recall, for example, Perronet's Pont de la Concorde in Paris, which I am confident could be little improved in its effective and economical use of material through the application of even the most advanced principles of modern analysis and design. Or the Gothic cathedral, masterpiece of skeleton-stone construction, which will probably remain man's greatest achievement in stone, for the age of stone masonry is past. These and countless other monuments of earlier engineering genius, from the Roman aqueduct to the truss bridge, attest the power and achievement of engineering as an art.

Economics Resolves the Conflict.~How then has it been possible for science to become so important a factor in engineering—to almost crowd art out of its ancient home? The basic force that has encouraged and still encourages this remarkable revolution is, I believe, economic. As Wellington said some sixty years ago:

"It is beyond doubt that the true reason for the striking progress in bridge building in recent years has been, not that men have been driven to excellence by the 'responsibility for human life' resting on them. . . . The impelling force has been the keen competitive struggle to bring the first cost of every bridge as low as possible, and yet do nothing which shall injure its permanent efficiency and compel it to be speedily rebuilt."

This is exactly what science in engineering permits the designer to do. Clearly, when we are able, through the use of applied mechanics and a knowledge of the strength of materials, to proportion each part of a structure or machine to the load it carries, the path is opened to securing material savings over a design that is purely the product of judgment and experience. Also, and directly dependent upon this technique, we may aspire to (and succeed in) the planning and erecting of structures of a magnitude that an earlier generation would have classed as fantastic—as the dreams of a visionary. The advent of a more scientific technique has opened the way to bigger and better structures and machines, to safer and more reliable design; it has made possible the modern paradox of less costly yet more efficient and effective service.

Science in Engineering.~One of the first consequences of this revolutionary change in technique was the establishment of engineering schools. When engineering was an art, education for its practice was through apprenticeship. With much of the basic technology of engineering rationalized and reduced to a science, much of this training could be transferred to the classroom, for such transfer resulted in an economy of time as well as in increased scope and efficiency of instruction.

This is reflected in the fact that before 1850 there were but two schools of engineering in the United States, whereas following the introduction of such books as Rankine's *Applied Mechanics* and his *Steam Engine*, there was a tremendous jump, so that by 1870 a total of seventy such schools were active—schools which frequently, as if to clinch the argument, bore the title "scientific." The engineering school was thus born of the revolution in engineering; its establishment marked the decay of an art and the birth of a science, and it has always been an ardent advocate and missionary of this movement.

Technics Gain Favor.~In earlier days the young graduate of such a "scientific school" had difficulties when he attempted to secure a position after graduation. He was not always enthusiastically welcomed by the so-called practical engineer. Yet today we virtually insist that graduation from an engineering school is a first essential to admission to a professional society and to professional registration. The young "scientific" graduate has something that is worth dollars and cents.

I venture to suggest, however, that the powerful and undeniable urge of economy only furnishes the impetus to ever-increased activity in reducing engineering to a science and that the fuller meaning of this movement lies still deeper. Standardization has been a concurrent factor in modern development, not only the standardization of structural and machine elements, structural shapes, screws and threads, reinforcing bars and pipes, but also—and this is even more important—of method. It is the profound effect which this rationalization and standardization of method has had on the conditions of modern engineering practice that requires special emphasis.

Standardization.~A century ago the practice of engineering was limited to those few extraordinary artists who possessed a natural gift for the art and had achieved skill and reputation through practice. Such men were few in number and, while we can but marvel at the magnitude and scope of their activities, it is inconceivable that a mere handful of outstandingly gifted men could meet the engineering needs of a modern world.

The reduction of the technique of engineering to a science has made possible a widespread extension of engineering all over the globe, for it has made it possible to carry out the great labor of engineering planning and design through the utilization of men of no superlative order of intelligence. Once the type of a modern structure, its general features and principles of design have been established, patience and skill, but no rare gift of genius, are required to elaborate its details; these follow as practically the inevitable product of an almost completely rationalized process of technical computation.

There is thus every reason, I believe, to expect that the movement for more science in engineering—now almost a mania, in academic circles at least—will be continued in the future.

Effect on Engineering Practice.~And how does this affect the professional practice and prospects of engineering?

To put it bluntly, the great bulk of engineering practice today is carried on by organized groups of technical employees—federal, state, and municipal departments on the one hand, or the highly organized functional divisions of industry on the other. The truly professional engineer is called upon only for the outstanding and the difficult—the special decision which requires judgment and experience. This functional organization of the technical practice of engineering is certain to develop and expand.

The professional engineer is thus primarily the modern representative of the art of engineering. He is preeminently the master of those problems in practice that are not solved in books. He is a court of last resort for the solution of problems that have not, as yet, been fully rationalized. He is the custodian of the one unchanging thing in our profession—those basic principles which make it a profession rather than a simple technology. Technique may change but principles remain.

Professional Engineering.~Yet the professional engineer must also be a pioneer in the scientific movement in engineering, in the development and application of new methods and refinements in design and construction. In a certain sense his activities are suicidal for he is a leader in the movement for rationalization which, through the reduction of engineering to a science, tends to eliminate the need for his special services—for judgment and experience.

Nevertheless the truly professional engineer occupies a key position from which he will never be dislodged. If engineering were a static profession, if its possibilities for service to mankind were fully developed and its technique fully rationalized, there would be no place for leaders, no need for further thought and pioneer effort. We know, however, that the history of our profession has been one of continuous evolution and growth. It is inconceivable that engineering can ever become fully rationalized and static. There will always be new frontiers, not only for the improvement of technical methods and practice, but also in the extension of engineering into new fields of activity. Not only are there older practices to be perfected and better methods to be discovered, but, if we are truly progressive, our profession will ever expand in scope and responsibilities. New horizons, new opportunities for service, are constantly being developed. The element of art in engineering will never be completely eliminated.

Path of Future Progress.~We are too apt to think only of the interesting and fascinating technical problems of our profession and to lose sight of its broader implications and possibilities. Engineering is not merely an instrumentality of Western civilization whereby man endeavors to meet his material wants and needs and to make himself increasingly master of his environment, it is habit of mind, a conviction, and a viewpoint, holding much greater potentialities. It is a habit of mind which recognizes that there is a rational way of doing things as opposed to the emotional, unreasoning, biased, partisan approach—which seeks to discover and perfect this honest path of science and reason. And it is a conviction that mankind can apply this method with profit, not only in one field but in the solution of a much wider variety of life's problems.

What opportunities there are in this picture, and what a challenge for the continued advance of our profession, for pioneering and leadership by those who guide its destinies, the professional engineer and the engineering school!

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California's Plan for Freeways in Metropolitan Areas

By FRED J. GRUMM, M. AM. SOC. C.E.

ENGINEER, SURVEYS AND PLANS, STATE OF CALIFORNIA, DIVISION OF HIGHWAYS, SACRAMENTO, CALIF.

THE freeway as distinguished from, or as a part of, the express highway, is an old idea with a new and important application. In 1939 the California legislature officially recognized its importance. In this paper Mr. Grumm describes how it was evolved, and the basic principles underlying its design. To really appreciate the freeway one should travel the length of California by car from the projected Balboa Freeway in San Diego over the Santa Ana Freeway to Los Angeles, on the Arroyo Seco Freeway from Pasadena to Los Angeles, or on the Bay Shore or East Shore freeways around San Francisco Bay. Without these highways motor travel would be at times impossible in these sections. No doubt freeways will be used more and more in the future in the great metropolitan areas of the country.

IN California the rural state highways, which comprise 13% of the total rural mileage, carry about 75% of the traffic generated in rural areas. Even within city limits, 25% of the total traffic moves on state highways. Combining these two facts: of the 56 million vehicle-miles generated daily on the public roads and streets of California, about 45% are on the state highway system. Over 60% of the traffic on the rural state system is of urban origin.

These data, though few in number, carry a world of meaning. A thorough study of them and their implications has led us into a mass of planning, organizing, constructing, maintaining, and operating. This is one of the jobs entrusted to the State Division of Highways.

Of the many and varied problems inherent in this work, traffic congestion probably claims our most constant attention. Various means for relieving it have been applied. The method here discussed is perhaps old as a concept, but is relatively new in its application to highways, in California at least. It is the "freeway."

From the data given previously it is evident that the state highway system carries the majority of the traffic. It follows logically, and it is in fact true, that the major traffic arteries within and between centers of population are, with very few exceptions, a part of the state system. With improvements to provide greater capacity on these arteries the volume of traffic they carry increases, and abutting land becomes more valuable. Its conversion into business frontage, especially in urban areas, seems almost an inevitable result. And so springs up the "ribbon city"—gradually extending from an urban area for miles along the highway.

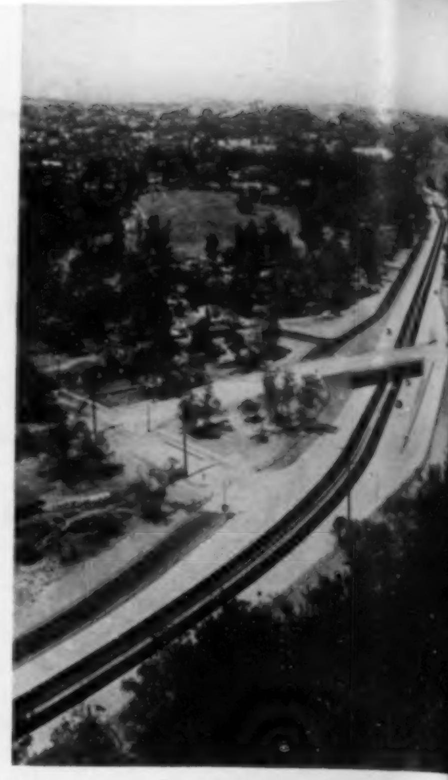
PORTION OF THE ARROYO SECO FREEWAY PASSES THROUGH FOUR TUNNELS

This type of improvement of abutting land induces traffic, creates stopping, parking, and conflicting movements of vehicles; in other words it produces congestion and hazard. Uncontrolled access to the highway from abutting property so developed, and the volume and movement of traffic induced by this development, quickly reduces the efficiency and capacity of the road. The highway becomes a congested local service road.

It is the motorist who contributes the funds that pay for the right of way and for the improvement of the roadway. But under the conditions described it is the owner of the abutting land who receives the main benefit, although he has contributed nothing to the improvement, and in fact actually has received payment for the right of way taken plus severance or contingent damages. At the same time he creates the condition that diminishes the value and service of the highway. The motorist sees his investment diverted to benefit adjacent property, rather than himself. The intended function of the facility he created is so badly impaired, if not entirely destroyed, that he has just cause for complaint and criticism. Such conditions, perilously acute, especially near the larger metropolitan centers, must be cured.

To build an additional road paralleling the first for more adequate traffic service only

(LEFT) GROUPS OF MULTIPLE LANES MARK CAHUENGA PASS FREEWAY, LOOKING TOWARD VENTURA BOULEVARD



(RIGHT) ARROYO SECO FREEWAY AT HERMON AVENUE CROSSING HAS INNER LANES OF ASPHALT CONCRETE AND OUTER LANES OF PORTLAND CEMENT CONCRETE

RAMONA FREEWAY HAS A BRAIDED INTERSECTION FOR TRAFFIC EXCHANGE

SYCAMORE TREES ALONG PARKWAY SAVED BY ENCLOSING THEM IN CIRCULAR WALLS

SLOPE TREATMENT BETWEEN OVERPASSES UTILIZES FLOWERING SHRUBS AND BUSHES

INLET AND OUTLET RAMPS ON ARROYO SECO FREEWA AVENUE 52 CROSSING, ADJACENT TO STORM-WATER D

(LEFT) SLOPES ALONG DEPRESSED SECTION OF ARROYO SECO FREEWAY PROTECTED WITH PLANTING

means a repetition of the same difficulty. To convert the afflicted highway into a three-way road, that is, one with central lanes for through traffic and service lanes or outer roads adjacent to the abutting property, will meet with violent objections from the abutting business development which now has and claims frontage access. It is also decidedly expensive. More right of way must be purchased to make room for the expanded roadway, which usually involves removal of improvements. The construction cost is naturally larger, and to this must be added the future maintenance of the extra roadways.

Thorough consideration of the problem led to the adoption in California of the "freeway" principle in the design of major arteries. At the request of the State Division of Highways, the Legislature in 1939 enacted the laws providing for establishment of freeways in California. The legal definition of a freeway is "a highway in respect to which owners of abutting land have no right or easement of access to or from their lands or in respect to which such owners have only limited or restricted right or easement of access." The act provides that such access must be acquired by the state and authorizes such acquisition by action in eminent domain. The act sets up further provisions to make the freeway principle effective:

"The department is authorized to enter into an agreement with the city council or board of supervisors having jurisdiction over the street or highway, and as may be provided in such agreement, to close any city street or county highway at or near the point of its interception with any freeway or to make provision for carrying such city street or county highway over or under or to a connection with the freeway and may do any and all work on such city street or county highway as is necessary therefor. No city street, county road or other public highway of any kind shall be opened into or connected with any freeway unless and until the California Highway Commission adopts a resolution consenting to the same and fixing the terms and conditions on which such connection shall be made and the said commission may give or withhold its consent or fix such terms and conditions as in its opinion will best subserve the public interest."

The department has set up and uses the following procedure in establishing freeways on the state system:

1. A resolution is adopted by the California Highway Commission declaring a state highway a freeway.
2. With the governing body of the city or county in which the freeway lies, an agreement or contract is made with respect to the freeway and the treatment of connecting and intersecting roads or streets.

WHAT IS A FREEWAY?

It is necessary, here, to call attention to a distinction between the definition of the "freeway" as set forth in the state law and the generally accepted meaning of the term. Various designations have been used for this type of highway, such as "limited highway," "express highway," "super-highway," "parkway." These suggest freedom from speed restrictions, from conflicting movements such as cross-traffic, left-hand turns, and adjacent property access. The mental picture envisions a highway with all the safety-ensuring appurtenances—with opposing lanes separated, with cross traffic carried over or under, with entering or departing traffic blending or filtering into the traffic stream or leaving it easily by speed-change lanes, with no left turns and no pedestrians, with no traffic movement across the right-of-way line, and with landscaping to satisfy the esthetic sense.

The legal freeway, in California, has only one of these features—restriction of access from abutting lands. In other words, under our law a "freeway" could be built with none of the numerous devices of design promoting comfort and safety, so long as it embodied the principle of restricted access from abutting land. Conversely, we could build into any state highway the various fea-

Aerial View of Marmion Way Bridge Across Arroyo Seco Freeway

tures to provide protection and freedom from restriction of movement, and achieve the generally accepted concept of a freeway, but unless access restriction from abutting property were included, it could not legally be termed a "freeway."

The envisioned freeway with a wide right of way and all the safety-ensuring appurtenances is costly. Especially is this true in urban areas where property values are high, but where the freeway is most needed. Construction of any highway on such a plan would be expensive whether labeled "freeway" or not. On the other hand, access rights are not necessarily expensive. This is particularly true on a new location where there are no established frontage rights. The average cost, up to the present, on a large mileage of declared freeways, is less than 75 cents per ft of frontage.

Fortunately, then, under the law we can take advantage of the situation to establish freeways on potential large-traffic routes. We can ensure protection against impairment of their integrity by acquiring access rights. Some of the other more expensive freeway features may be deferred for a time until traffic volume requires and justifies their installation. In this manner it is possible to create freeways at only a little higher cost than ordinary highways. Our program may, therefore, and does include both types of freeway—the one complying with the legal definition, adaptable to further development in the future, and the other the fully envisioned, all-comfort-and-safety inclusive travel facility—the freeway in the fullest sense of the word.

As of August 16, the length of declared freeways on the state highway system totals 156.2 miles—about 80 miles in the south of the state and 75 miles in the north. The majority of this mileage lies on major arteries leading into, through, and radiating from the larger population centers. On these highways, plans contemplate complete freeway development.

A general picture of the background has been presented—the need and the remedy—and the extent to

which the freeway principle has been applied. A brief consideration of basic principles and factors influencing the design is now in order.

The installation of a freeway will have a definite effect on traffic movement over a considerable area laterally as well as adjacent to the termini. It may mean a change in habits for many motorists such as the

ARROYO SECO FREEWAY INTERSECTS NORTH FIGUEROA STREET IN BRAIDED CROSSING

commuter. The limitation of access to the freeway—that is, the number of openings into and out of it—may cause a major redistribution of traffic on feeder roads. A program of education and direction may be required to ensure its proper and efficient use.

Too many opportunities for access, too frequent spacing of inlets and outlets, leads to local use of the freeway for short stretches. Such use is undesirable especially if other facilities exist to serve the local traffic. Consideration of these matters influences the selection of route, location, and access.

We know that there is a growing tendency for traffic to abandon other routes for the freeway. This must be considered in determining capacity. Anticipated volume and character of traffic indicates the capacity—the lane width and the number of lanes. Most of the freeway mileage in California is designed as a four-lane divided roadway; some mileage has been built to six and eight-lane widths.

Dispersion of traffic from the freeway near its termini is an important feature. Contact and connection with an adequate street pattern at these points is necessary.

Mass transportation by bus must be included in the considerations. A single motor coach can carry as many persons as twenty regulation private vehicles. Evidence at hand shows that in the two larger metropolitan areas of the state the average load is 1.75 per private passenger car. Loading zones must be located away from traffic lanes and in such manner as to prevent pedestrian access to the freeway.

Right of way is often a controlling feature in the selection of location and in the design of the freeway. Highly developed improvements on high-value land mean large expense for right of way. A narrow right of way dictates a narrow median strip and less room alongside the traveled lanes. A freeway on an existing highway or street requires acquisition of established frontage—approximately the cost of the entire holding—or the installation of outer roads to serve such frontage. Both methods are usually more expensive than location through areas where no frontage rights exist.

Outer highways or side roads separated from the central freeway are an added expense for right of way, construction, and maintenance. Proper location and design may often make them unnecessary. They are, however, required in cases where the closing of intersecting roads or streets would cause cul-de-sacs and consequent higher contingent damage. Contingent damage may also result from impaired frontage caused by grade separation structures and impaired circulation of traffic. Again these possibilities must be taken into account in location and design.

DESIGN OF THE FREEWAY

The fully developed freeway must provide freedom from traffic restrictions—no stops, no conflicting cross-traffic, no infringement from abutting land, no left turns, separation of opposing traffic, no pedestrians, ample lane width, adequate capacity, generous alinement, absence from distracting influences, speed-change lanes for departing and entering traffic, adequate signs and directional information. In short, the design must be based on the principle of free and safe traffic flow.

Spacing of grade separations, entrances and exits, will depend on areas to be served, local conditions, and traffic movement. Separation of cross-traffic eliminates stops and conflicting movements; access rights eliminate the infringement from abutting land; a curved or positive separation strip eliminates left turns and affords protection against opposing traffic; fences and separation structures bar the pedestrian.

The freeway agreement with the local authority—city or county—should definitely set forth the general scheme for the ultimate treatment of intersecting roads or streets. It should not necessarily imply immediate construction of the ultimate design. It does not include all details of the design. It is intended to indicate the method by which the freeway will be developed and the extent of state expenditure. Agreements may be supplemented as need arises. In accordance with the provisions of the law, however, the state has the authority to fix conditions under which any additional roads or streets may enter or cross the freeway.

The acquisition of right of way and access rights should be based on ultimate design requirements. Initial construction, however, may include a roadway with only grade intersections, four-lane divided capacity, or even a two-lane highway. The major requirement for the freeway is accomplished with the acquisition of access rights. The realization of the ultimate design may be deferred, depending on the requirements of traffic.

Not all state highways need be or will be freeways. A relatively small percentage of the public road mileage will be converted into this type. Freeways are needed principally on those highways and in those areas where a large or potentially large volume of traffic produces congestion and all its attendant evils—delay, increased operating expense, shattered nerves, accidents.

The cry is heard: Property values will be destroyed. That need not be true. Already in our short experience, paralleling that of other localities where the freeway type of highway has been introduced, we find that through adjustment of land use and rearrangement of land improvement, larger benefits to real property attend the installation of a freeway. The freeway principle applied to the major traffic arteries on the state highway system offers a positive means of protecting the motorist's investment, does not destroy property values, and provides a lasting, more efficient, safer travel facility.

Shasta and Keswick Power Developments, Central Valley Project, California

By L. N. McClellan *and* C. L. Killgore

Respectively Chief Electrical and Mechanical Engineer, and Associate Electrical Engineer, Bureau of Reclamation, Denver, Colo.

To visualize the Central Valley Project in its entirety is difficult without knowing how all the various phases dovetail together. Conservation and distribution of Central Valley water will result in improved navigation, land preservation, and reclamation and power development. Power, as one of these phases, is necessary in order to satisfy the irrigation pumping requirements on the San Joaquin–Mendota Canal. This paper, describing how power will be developed at Shasta and Keswick dams, was presented in July before a session of the Power Division at the Society's Annual Convention in San Diego.

Latest of the federal government's multi-purpose water conservation and power projects to be undertaken by the Bureau of Reclamation, is the Central Valley Project in California. Its primary purpose is to provide additional water for the Sacramento and San Joaquin valleys (Fig. 1), which extend over 500 miles down the center of California and contain one of the nation's richest and most important agricultural areas.

The principal features of the project comprise the Shasta Dam and power plant on the Sacramento River about 9 miles north of Redding, Calif.; the Keswick Dam and power plant, also on the Sacramento River about 6 miles downstream from Shasta Dam; the Sacramento–San Joaquin delta cross channel which will transfer water from the lower Sacramento River to the lower San Joaquin River; the Contra Costa Canal, which will supply water for irrigation, municipal, and industrial purposes in an area east and south of San Francisco Bay; the Friant Dam on the upper San Joaquin River; and

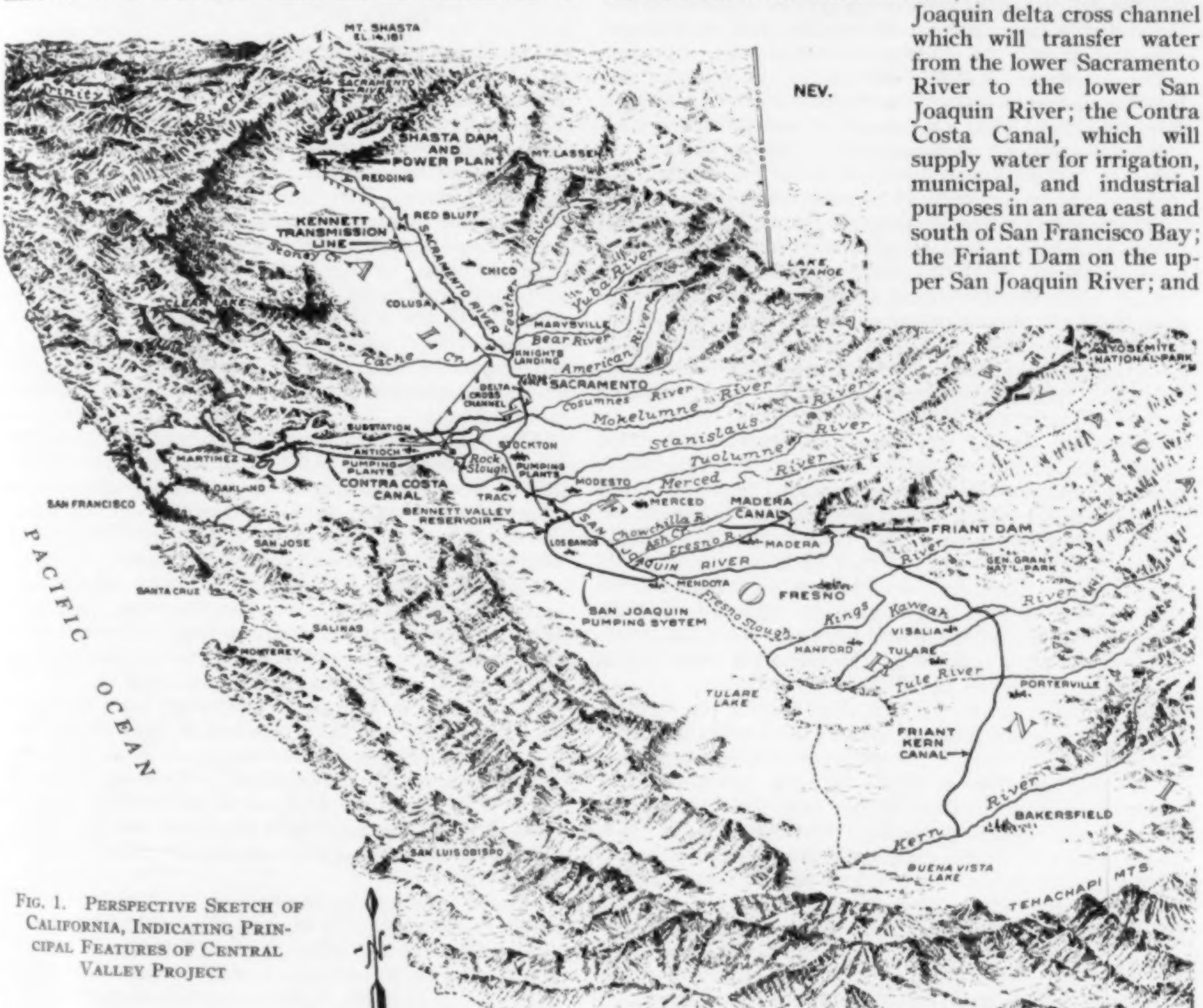


Fig. 1. Perspective Sketch of California, Indicating Principal Features of Central Valley Project

Steel Scroll Case and Speed Ring for Shasta Power Plant Being Assembled in the Shop

the Madera and Friant-Kern canals, which will distribute water from Friant Reservoir to lands in the San Joaquin River valley. In general, the purposes of the Central Valley Project are improving navigation, regulating the flow of the San Joaquin and Sacramento rivers, controlling floods, providing for storage and for the delivery of the stored waters, and for the reclamation of arid and semi-arid lands. In effectuating these aims, such distribution systems will be built as the Secretary of the Interior deems necessary, and electric energy will be generated and sold as a means of financially aiding such undertakings. All necessary appurtenances will be provided to permit the full utilization of the works constructed and to accomplish the purposes listed.

Shasta power plant is designed for an installation of five main generating units each rated at 75,000 kw at a head of 330 ft. With the Shasta Reservoir at the dead storage level, the static head is 238 ft, and at this minimum head the Shasta power plant will be capable of delivering 160,000 kw to the terminus of the transmission lines from Shasta Dam. With heads of 330 ft or higher, the plant will be capable of generating the full rated output of 375,000 kw.

Operation studies of Shasta Reservoir based on stream-flow records indicate that a critical period of power production would have occurred in 1934, which was preceded by four consecutive years of low runoff. The reservoir would have been drawn down to the dead storage level by the end of 1933, would have partially refilled during 1934, and would have been drawn down to the dead storage level again by the end of 1934. With the computed runoff and heads for 1934, the possible firm energy available at the terminus from Shasta Dam is estimated to be 720,000,000 kwhr.

The Keswick power plant is designed for the installation of three main generating units each rated at 25,000 kw at a head of 90 ft. The purpose of Keswick Dam is to provide an afterbay below Shasta power plant to maintain a uniform flow in the river and permit the Shasta power plant to supply peak-load power. The dependable firm output capacity available from this plant during critical periods, such as in a year like 1934, will be limited by the release from Shasta Reservoir. Studies show that the minimum release will average 4,700 cu ft per sec, which will deliver 32,000 kw continuously to the terminus. It is estimated that the Keswick power plant will deliver 200,000,000 kwhr annually during such a minimum year. The total firm energy available at the terminus of the transmission lines from the Shasta and Keswick power plants will be 920,000,000 kwhr annually.

As the San Joaquin-Mendota Canal requires a pumping lift of 210 ft, the delivery of an average of 600,000 acre-ft per year through this canal will require approximately 200,000,000 kwhr for pumping. Operation of the five pumping plants on the Contra Costa Canal will require approximately 20,000,000 kwhr per year, making a total of 220,000,000 kwhr required for irrigation pumping. The surplus firm energy available from the Shasta and Keswick power plants, after providing irrigation pumping requirements, will be 700,000,000 kwhr per year.

From year to year the output of the Shasta and Keswick hydro plants will vary widely, depending upon the runoff of the Sacramento River. In order to increase the dependable power output during dry periods and to convert the secondary hydro energy which will be available during wet periods into firm energy, it is proposed to supplement the hydro power with steam generating capacity to the extent of 150,000 kw. The combined dependable capacity of the system will then amount to 342,000 kw delivered at load centers, and the system will be capable of delivering 1,950,000,000 kwhr of firm energy per year. Deducting the 220,000,000 kwhr required for irrigation pumping, will leave 1,730,000,000 kwhr of firm energy annually for commercial sale.

POWER HOUSE AT SHASTA DAM

The Shasta power house is a reinforced concrete structure 76 ft wide and 446 ft long, located a short distance downstream from the dam on the west bank of the river, with the longitudinal axis of the building and generating units approximately parallel to the river channel. The power house has a control bay, a service bay, and five main-unit bays. The main generating floor is at El. 616, and the main step-up transformers are located on a deck along the tailrace side of the power house.

In addition to the station-service generating and switching equipment, the control and service bays accommodate the station sump pumps, air compressors, machine shop, oil-handling equipment, 125-v storage battery, main battery distribution board, offices, telephone switchboard, control-cable racking trays, and main control board.

The main turbines for Shasta power plant are being manufactured by the Allis-Chalmers Company. They are of the vertical-shaft, spiral-casing, single-runner, Francis type, each rated at 103,000 hp at a net head of 330 ft. They will operate at a speed of 138.5 rpm and will be direct connected to the generators.

Since the Shasta Reservoir must be operated primarily for irrigation and other purposes, and power generation is an incidental function, wide fluctuations will occur in the reservoir water surface. The maximum will be at El. 1,065 and the minimum at El. 828. The water surface of the tailrace will vary from about 47 ft above to 8 ft below the center line of the turbine, resulting in a net effective head varying from a minimum of 238 ft to a maximum of 475 ft. However, it is anticipated that minimum-head conditions will occur only at infrequent intervals of short duration, and that the net effective head will be 408 ft or higher about 75% of the time.

Studies of these hydraulic operating conditions indicated the advisability of a low-speed turbine. A turbine rating of 103,000 hp at a net effective head of 330 ft was selected in order to secure more power output at reduced heads. The turbines, designed to operate at best efficiencies between heads of 380 and 400 ft, are required to develop not less than 50,000 hp each at the minimum head of 238 ft.

The wide variation in operating head required a turbine runner designed for an exceptionally wide range of operation, and extensive model tests were made in the manufacturer's hydraulic laboratory with a complete unit in a setting homologous to that of the power plant. Based on these model tests, the guaranteed efficiencies are 89.6% under a head of 408 ft at 103,000 hp; 83.5% under a head of 238 ft at 45,000 hp; 84.5% under a head of 475 ft at 103,000 hp; and for the highest efficiency, 90% under a head of 380 ft at 103,000 hp. The turbine runner is 15 ft 4 in. in diameter and its flywheel effect is 2,750,000 lb at a 1-ft radius. The runner weighs 85,000 lb and the total weight of the turbine rotating parts is 175,000 lb.

All rotating parts of the turbine are designed so that the maximum unit stress due to the runaway speed does not exceed two-thirds of the yield point. The runaway speed of the turbine under a net effective head of 475 ft with no load on the generator, except windage and friction, will not exceed 270 rpm. The runners are guaranteed against excessive cavitation or pitting for a period of one year when in service at heads of 238 ft or higher. Excessive cavitation or pitting is defined as the removal of 500 cu in. or more of metal from the runner. The turbine shaft is provided with an axial hole 6 in. in diameter bored through its entire length to facilitate inspection of the shaft, which will be plugged at the flanges, and with radial holes connecting with the axial hole for the purpose of admitting air from the cover plates to the center of the runner.

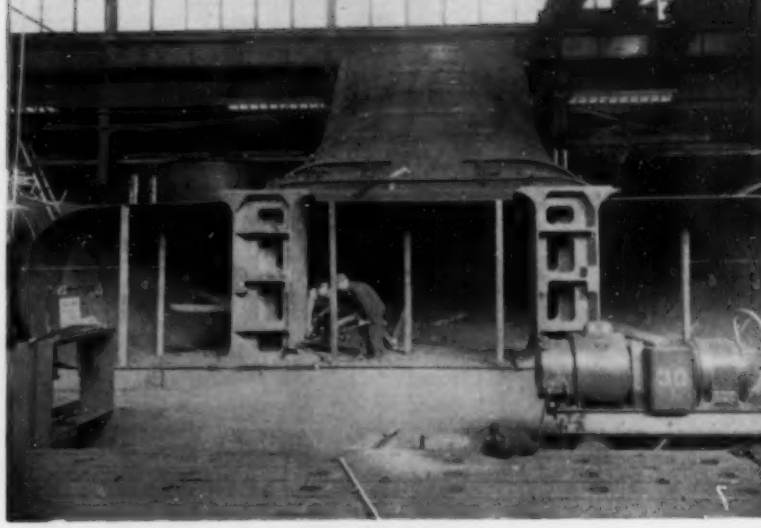
The turbine guide bearing is of the pressure oil-lubricated type. Duplicate motor-driven oil pumps, one with an a-c motor for regular service, and one with a d-c motor for emergency service, having an oil-pressure-controlled automatic starting switch, are provided for each turbine guide bearing.

AN INNOVATION IN LARGE TURBINE DESIGN

It has been the usual practice heretofore to build the spiral casings for turbines of this capacity of cast steel. In this instance the manufacturer adopted an innovation in large turbine design and is fabricating these turbine casings from plate steel. The use of a welded plate-steel design has proved a practical solution. The various plate-steel sections are $2\frac{5}{16}$ in. thick, shop welded to the central cast-steel speed-ring sections. The field connections of the speed ring will be bolted together as shown in one of the accompanying photographs. The casing is divided into seven sections and one straight inlet section, and these will be joined together in the field by 1-in.-thick, double buttstraps with $1\frac{1}{4}$-in. diameter straight button-head rivets having raised countersunk heads on the inside. This type of rivet was adopted after special tests were made to determine the most satisfactory type of riveted joint for the casings, both for strength and driving properties. All joints and rivets must be tight against an internal hydraulic pressure of 310 lb per sq in.

The main generators for Shasta power plant (Fig. 2), which are being manufactured by the General Electric Company, are rated at 75,000 kva, a unity power factor, 138.5 rpm, 13,800 v, 3 phase, 60 cycle, and are of the vertical-shaft type. The generators are of conventional design, with a thrust bearing at the top of the unit which carries the entire weight of the generator and turbine rotating parts. They are also provided with upper and lower guide bearings, surface coolers, and direct-connected main and pilot exciters.

Studies of the proposed 230-kv transmission lines indicated that these lines should be operated normally



DRAFT-TUBE LININGS, MADE OF $1\frac{1}{4}$-IN. WELDED PLATE STEEL, WERE ASSEMBLED IN THE SHOP BEFORE DELIVERY

at about unity power factor and that the stability of the power system would be increased with generators designed for this power factor. Therefore, the generators were so specified. However, since they have considerable overload capacity, they can safely carry 75,000 kw at a slightly lagging power factor if the performance of the transmission lines should indicate this to be desirable. Each generator has a line-charging capacity at a rated voltage and frequency of 96,000 kva.

The generators are rated at a maximum temperature of 100 C, but are provided with full Class B inorganic insulation in accordance with the standards of the American Institute of Electrical Engineers, having a maximum safe operating temperature of 120 C. The output that a generator will carry continuously at this maximum safe operating temperature is 115% of the normal output at 40 C, ambient. Since the generators are water cooled and the turbines will have surplus capacity at the higher heads, it is anticipated that the generators can be operated at overload capacities during times of higher heads and thus increase the power output.

Each generator has a flywheel effect of 84,500,000 lb at a 1-ft radius, which is required for system stability to keep the generator in synchronism with other rotating apparatus connected to the system during fault conditions on the transmission lines. The calculated transient reactance of each generator is 24% and must not exceed 27%, as determined by test. The short-circuit ratio is 1.6. These values are of normal design for generators of this capacity and will provide adequate stability for the system. The generators are provided with amortisseur or damper windings, of the non-continuous, low-resistance type. The guaranteed efficiency of the generators is 93.1% at 25% rated output; 96.05% at 50% rated output; 97.0% at 75% rated output; and 97.35% at 100% rated output.

The generator stator frame is fabricated from rolled steel plate and the stator core is built up of high-grade non-aging silicon steel punchings. The armature windings are star-connected, suitable for either grounded or ungrounded neutral operation. Standard overall differential relay protection, with accurately balanced current transformers of the same rating in the full winding leads at both ends of the stator, is provided for protection against grounds and short circuits between phases. Twelve embedded temperature detectors in the slots are distributed in groups around the periphery of the stator.

A center structure supports the rotor spider, which consists of a free or floating rim composed of steel laminations punched for dovetail poles. The rotor hub is bored for the shaft with suitable allowance for a shrink fit.

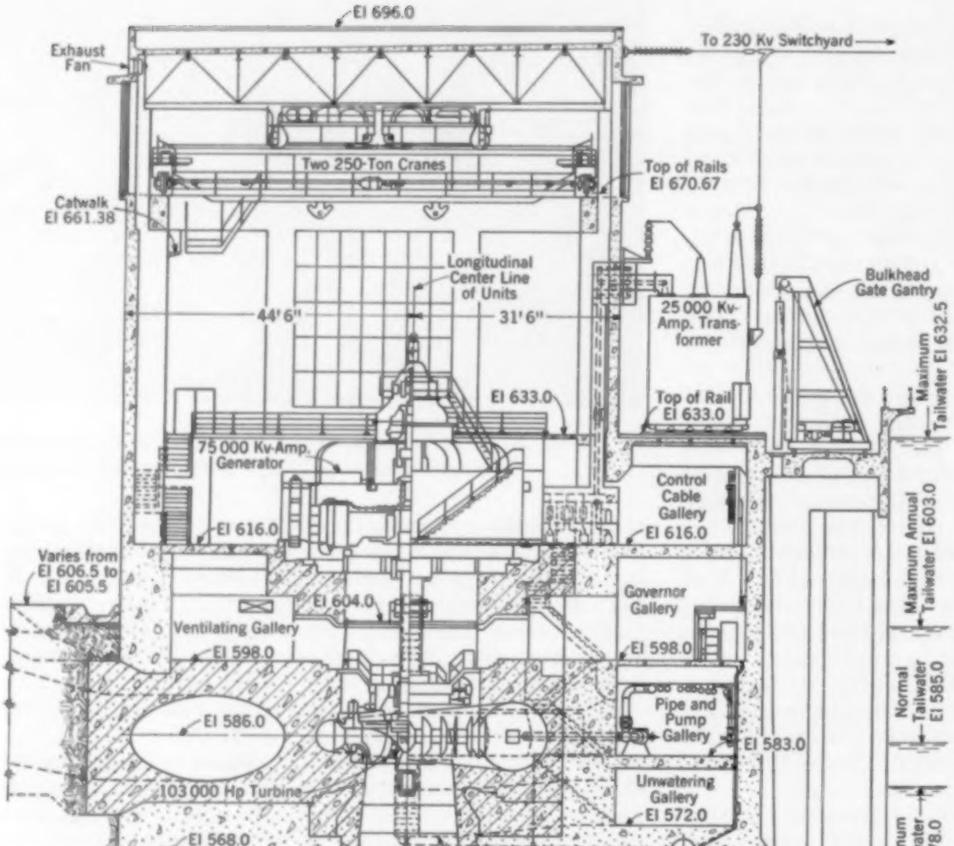


Fig. 2. Typical Cross Section Through a Main Generating Unit in the Shasta Power House

The shafts are made of forged heat-treated carbon steel, with coupling flanges forged integrally with the shaft. Each shaft has a hole 6 in. in diameter bored axially throughout the entire length for inspection of the metal. The generator shaft is 38 in. in diameter.

The generators are of the closed ventilated type, practically airtight to permit the use of automatic carbon-dioxide-gas fire-extinguishing equipment, and arranged to discharge the warm air through openings in the frame directly into the ventilating housing surrounding the generator. The air, after passing into the hot-air chambers, passes through surface air coolers into cool air chambers and from there back into the generator. The surface coolers have sufficient capacity to maintain the temperature of the air entering the generator at 40 C, or less with one cooler out of service and with the generator delivering the full rated output.

Air-operated friction brakes are provided for the generators. These brakes are designed to stop the rotor when the speed has dropped to 30 rpm after excitation is removed and the turbine wicket gates are closed. Brakes are required because the friction losses are so low that even though the leakage through the turbine wicket gates is small, the rotor would continue to run indefinitely at a slow speed. The brakes will act as hydraulic jacks to lift the generator rotors a sufficient distance to permit removal or adjustment of the thrust bearing.

The generators are provided with thrust bearings of the General Electric spring-type designed to operate successfully for a period of 15 minutes at 277 rpm, runaway speed, with a total load of 1,800,000 lb. The unit pressure on the thrust bearing is 400 lb per sq in. and the expected operating temperature of the lubricating oil is 50 C. The oiling system for the thrust bearing consists of a bath of oil contained in the bearing housing with no circulation of oil from an external source. The upper and lower generator guide bearings are self-oiling.

Each generator is provided with a direct-connected, direct-current, vertical-shaft, shunt-wound type, 250-v, separately excited main exciter mounted on top of the thrust-bearing housing, and a direct-connected, direct-current, vertical-shaft, compound-wound, 250-v, self-excited pilot exciter mounted on top of the main exciter. The capacity of each main exciter is 10% in excess of, and the pilot exciter is 50% in excess of, the actual capacity required. In order to increase the stability of the system, quick-response excitation of the main generator field and exciters is provided. Neither a main field rheostat nor a field circuit breaker will be used in the main exciter leads which will be connected directly to the rotor slip rings without being brought out from the main generator assembly. Control of the main exciter voltage and generator field current is accomplished entirely by controlling the field current of the main exciter by means of an automatic voltage regulator of the high-speed bridge type, with non-continuously vibrating contacts. Circuit breakers are provided to automatically open the main exciter field circuits upon operation of the generator protective relays.

Progress on the construction of Shasta Dam and power plant is being expedited as rapidly as modern construction methods will permit. Since hydroelectric power is so essential for national defense industrial activities, the Bureau of Reclamation is now doing everything possible to speed completion of the Shasta and Keswick power plants. It is anticipated that the first power will be available from them by the fall of 1943.

The design of the Shasta power plant was prepared under the direction of L. N. McClellan, chief electrical and mechanical engineer, of the Bureau of Reclamation. All designs prepared by the Bureau are under the general direction of J. L. Savage, chief designing engineer; all engineering and construction work is under the direction of S. O. Harper, chief engineer, Denver, Colo.; and all activities of the Bureau are under the general charge of John C. Page, Commissioner of the Bureau of Reclamation, with headquarters at Washington, D.C.

The Public Work Reserve

New Agency Has Long-Range Program to Solve Post-War Problems

By Melvin E. Scheidt, M. Am. Soc. C.E.

Principal Planning Engineer and Consultant on Programs, Public Work Reserve, Washington, D.C.

THE Public Work Reserve is a function of the Federal Works Agency, designed to develop and keep current a reservoir of needed public work, other than that of the Federal Government itself, such as can be undertaken after the reduction of present defense activities. Its purposes are: (1) to secure from all public agencies a listing of needed work to be done in the next five or six years; and (2) to assist local governments in developing and maintaining up-to-date long-range programs and plans for such work, covering five or six years.

One of the basic foundations of a sound and continuing national prosperity is the full employment of all persons capable of and willing to perform useful work. For the first time in many years, apparently this goal may be achieved through the current requirement to provide for the national defense. With all-out defense, we are building up our production to unprecedented heights. Already we have more people at work, are using more power, moving more freight, and turning out more goods of every kind than ever before. Furthermore, it is believed this will continue for another two or three years, unless the totalitarian powers collapse in the meantime.

This continued total effort for defense, plus the necessity to maintain the ordinary life of the country at a reasonable level, will require the full services of every available person and the nation will then be producing its maximum. However this is being accomplished largely as the result of the need to provide armaments and soldiers—things which do not contribute to our immediate standard of living.

In spite of this unprecedented production, our standard of living actually is being lowered, because, even with full utilization of all our resources, we cannot produce both armaments and domestic goods and services in full measure—a vast amount, both public and private, must go unsupplied or postponed in deference to our defense effort. Unless the world continues indefinitely to remain an armed camp, however, it is unlikely that we shall have to continue to divert such tremendous amounts of labor and materials from civic pursuits.

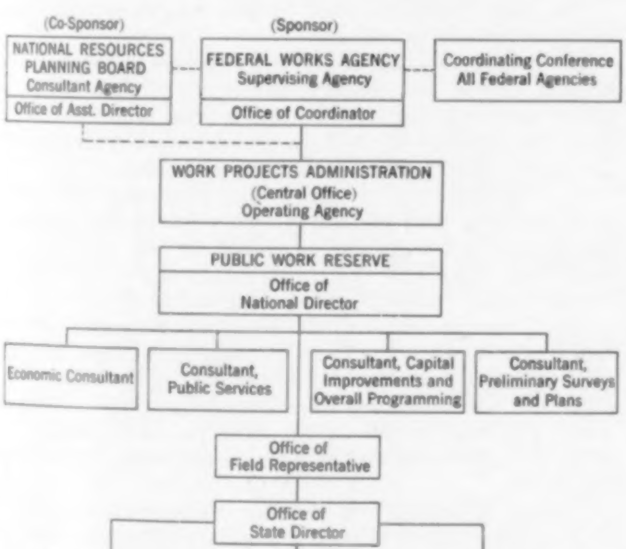


Fig. 1. Organization Chart Shows Relation of Activities

But at the time when national defense efforts are no longer needed we will have had to curtail many non-

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Front Entrance to a Great City—Cincinnati, Ohio
New Highway and Viaduct, a PWA Project, Eliminates Countless Hours of Traffic Jams

defense activities, both public and private, and will then face a large, but accumulated unfilled back-log of much-needed services, goods, and facilities. The release of defense workers will then appear not so much an unrelated problem of unemployment as an opportunity to begin the task of attaining some of these long-deferred ends. We must try to plan, now, on a national scale, for the orderly accomplishment of this objective.

Many months ago government executives started thinking about this problem. It was sensed that unless very comprehensive planning and preparation were carried out at this time, serious unemployment conditions might exist. The President therefore requested the heads of federal agencies to develop some practical plan. One of the results of this directive was the creation of the Public Work Reserve.

Of course it was realized, largely as a result of the experience in trying to cope with the unemployment problems of the depression, that public work alone will not serve to furnish employment to all available persons. The problem of maintaining an even keel economically and socially in the period that will follow the cessation of defense or war activities involves many factors in addition to public work, either of a construction or nonconstruction character. The development, coordination, and operation of our industries and of agriculture, the determination and control of fiscal policies, the national economy as a whole, must all be considered in the broad scheme of planning for the transition period.

These problems are for other agencies, public and private, to solve. The efforts of the Public Work Reserve will of course be coordinated with other post-war planning but will be limited strictly to the field of public work. Within this limitation, however, governmental agencies must be prepared for whatever role the general post-defense plans may assign, and the Public Work Reserve is designed to help bring this about. By developing well-planned programs of public work it may be possible to avoid the conditions that existed in the days of the CWA, and in the early days of the WPA, and to avoid such delays as were experienced during the initiation of the PWA in getting projects under way. During those times much "made" work was necessarily resorted to for furnishing emergency employment, with its resultant unfavorable results and reactions in many places.

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AQUATIC PARK AT SAN FRANCISCO, BUILT BY WPA WORKERS, PROVES POPULAR DURING SUMMER MONTHS

A tremendous amount of public work, both construction and non-construction, needs to be done, merely to catch up with existing public needs—certainly more than can normally be financed within a few years by state and local units. Such problems as housing, soil conservation, water supplies, sewage collection and disposal, hospitals, schools, traffic and transportation facilities, recreational and educational facilities, hospital and home aids, proper coding and classification of local government records, are typical. But they represent only a few examples.

THE WAY THE PLAN WORKS

In the aggregate all of these projects could profitably employ great numbers of persons for several years before even catching up with current requirements. It remains then to perfect plans that will make the work available for immediate operation whenever the need for increased employment becomes apparent, and funds are made available from some source.

This, in brief, is the objective of the Public Work Reserve. It will operate through the facilities of a nation-wide WPA project, sponsored by the Federal Works Agency and co-sponsored by the National Resources Planning Board (Fig. 1). These two agencies will have general supervision over the work. Under a National Director in Washington, there will be four regional offices, each in charge of a Field Representative. These offices will be in New York, New Orleans, Chicago, and San Francisco. In most states there will be a State Director with a staff of assistants including engineers, finance analysts, public service experts, and others, to assist him in working with the local officials in developing their programs.

The operation of the Public Work Reserve will be limited largely to activities within the province of state and local governments. Programs proposed by federal agencies which interest state and local governments or lie outside the usual scope of federal operations will be brought to the attention of the Reserve and of the local agencies interested. In all other respects, however, the activities of the Reserve will be limited to the field of state and local government.

The complete range of activity contemplated by the Public Work Reserve for the accomplishment of its objective may be briefly summarized as follows:

1. Compile a complete listing of public improvements or facilities which state and local governments feel to be desirable or needed, together with such plans and estimates as are available.
2. Assist local government units, where necessary, in the full development of studies, surveys, designs, and plans for each project listed which presents substantial merit, to the end that every project on the shelf will ultimately be completely planned and available for immediate operation.
3. Encourage and assist state and local governments in comprehensive planning and in the development and periodic revision of definite long-range programs based on the budgetary limitations of the local government itself.
4. Continue to review and revise the lists of projects, in order that they may be kept current at all times.

All these objectives cannot be reached immediately but ultimately the entire field will be covered. If, finally, all local governments can be brought to accept the very great value of planning beforehand, there will always be available a shelf of nation-wide projects to draw on. This will enable a rapid acceleration of public work activities by telescoping two or three normal years' activity into a shorter period if the need requires.

DEFINITE PROCEDURES IN VIEW

The operations of the Public Work Reserve field staff will be based in part upon procedures developed by the National Resources Planning Board for the preparation, by municipalities, of long-range continuous programs. These procedures were worked out through a series of demonstration studies conducted in seven cities, as noted in the booklet recently published by the Board, entitled "Long-Range Programming of Public Works."

The operations involved in this long-range programming are briefly as follows:

1. A complete list of the improvements judged to be needed in the community, arranged in some order of preference, is compiled by some central authority of the local government from data and lists submitted by all the departments of the government concerned.
2. The financial resources and commitments of the governmental unit are analyzed to determine the funds which will probably be available or can be provided within safe limits for the construction of public improvements during the years covered by the program.
3. Those projects which, after comprehensive review and evaluation by the local officials in the light of overall community need, are tentatively selected for construction, are scheduled over a predetermined number of years (preferably six) in the order of their urgency or relative desirability and in direct relationship to the funds available.

Financing for the first year (or biennium in the case of state governments) of such a schedule is recommended as the capital outlay budget for the fiscal period. The remainder of the program is considered tentative pending future annual or biennial revisions. At the end of each year, or biennium, as the case may be, the program is

reviewed, revised, and extended. New projects may be added. If advisable, projects no longer justified are eliminated; others may be shifted in position in the schedule. An additional year is added to the schedule to replace the year just completed, and the revised list of projects is again scheduled over the full period of the program. The first year of the revised schedule is then recommended as the ensuing year's capital outlay budget.

Since developing this procedure, the Board has maintained a small staff of consultants in the field for the purpose of advising and assisting state and local governments. These men will assist the Public Work Reserve field staff and state and local officials in the task of preparing the reservoir and in advance planning, and will act in a general capacity as consultants and advisers.

This entire programming operation is not to be undertaken immediately by the Public Work Reserve field unit. Rather, a step-by-step procedure will be followed. In this period of emergency it may be essential almost overnight to embark upon a program of construction designed to provide employment in the face of declining defense operations. Therefore the first essential is to find out as quickly as possible what needed or useful projects are available for construction, what the total volume of proposed public improvements construction is, what kinds of projects are involved, and what is their distribution. It is also essential that all governmental agencies be made aware that such an emergency may arise so that they will begin now to prepare detailed plans for their needed improvements.

The first work of the field staff will therefore be to assist local governments in undertaking Step 1 of the programming operation—the compilation of lists of needed improvements.

MANY DETAILS TO BE COVERED

Proposed projects will thus receive the benefit of a certain amount of overall thinking and will reflect the general requirements of each area concerned. Development of financial analyses, and the other considerations involved in the complete programming will come later, as time permits, since the functions of the Public Work Reserve are conceived as a continuing operation.

Not only will the field staff of the Public Work Reserve encourage state and local governments to view their public improvement needs in a comprehensive fashion, but it will also accumulate data from these agencies with which to compile a national list of such undertakings. Assembly of such data will permit the planning of nationwide public work programs of several kinds, designed to meet any one of a number of assumed conditions. The information required in this initial listing will cover both construction and non-construction needs and will be submitted on forms prepared for the purpose, copies of which will be retained by the local officials to be used by them later in the full programming operation. These forms are known as prospectuses.

The information desired regarding proposed undertakings includes a description and location of the work, an estimate of its cost, the proposed manner of financing, an evaluation of priority with respect to other undertakings of the agency, and an appraisal from the standpoint of public usefulness and relative value as a means of affording employment. The Reserve will provide personnel to permit the compilation of these data without undue expense or effort on the part of the governmental agency from which the information is requested.

It must be emphasized that a prospectus is simply a record of a needed or desired undertaking and is not to be considered as an application to the Federal Government for assistance; nor is it to be considered as a statement of work involving any obligation on the part of the local government unit to prosecute or finance at any specific time or to any specific extent. Prospectuses are to be considered merely as information with respect to the location, magnitude, and character of local public work which the local governments themselves desire or need.

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PEDESTRIAN OVERPASS ON CHICAGO'S OUTER DRIVE ROAD, BOTH CONSTRUCTED BY WPA

In order that proposed projects may be immediately available, complete working plans must be ready. State and local governments are urged to give serious thought to this phase of the program, and, in so far as is presently possible, to begin now the preparation of detailed plans for those of their more urgent projects which they believe will go forward if and when funds are made available, either from local or other sources. The Public Work Reserve proposes to provide a certain amount of help to local agencies when needed for this phase of the work, but funds now available are extemely limited.

Finally, the Public Work Reserve, in assisting state and local governments in the preparation of the lists and in the subsequent planning and programming, will at all times emphasize:

1. That the function of its personnel is merely to assist the state or local authorities; that the determination of what projects are to be included in the lists and subsequent programs, the establishment of priorities relative thereto, and the scope or fields to be covered, all are entirely the responsibility and authority of the local government. The inventory, as well as the subsequent programs, if and when adopted, will be based solely upon local desires and needs; and

2. That it does not desire or intend to artificially stimulate or expand public work needs or activities, but rather (*a*) to assist in the establishment of a well-planned national shelf of potential work based upon actual need and available for use when required, and (*b*) to establish a procedure and form of assistance which will encourage the local government to plan an orderly and thoughtful scheduling of such work as it may see fit to finance within its own budgetary limitations.

The objective of the Public Work Reserve in encouraging state and local governments to prepare long-range programs of public work is to insure that the nation as a whole may have well coordinated and planned projects. These are to be prepared not only to meet the ordinary ability to finance locally but also to meet any urgent need for expanded public services and facilities as a factor in providing additional employment at a time of emergency.

Placing the All-American Canal in Operation

By L. J. Foster

Construction Engineer, All-American Canal, U.S. Bureau of Reclamation, Yuma, Ariz.

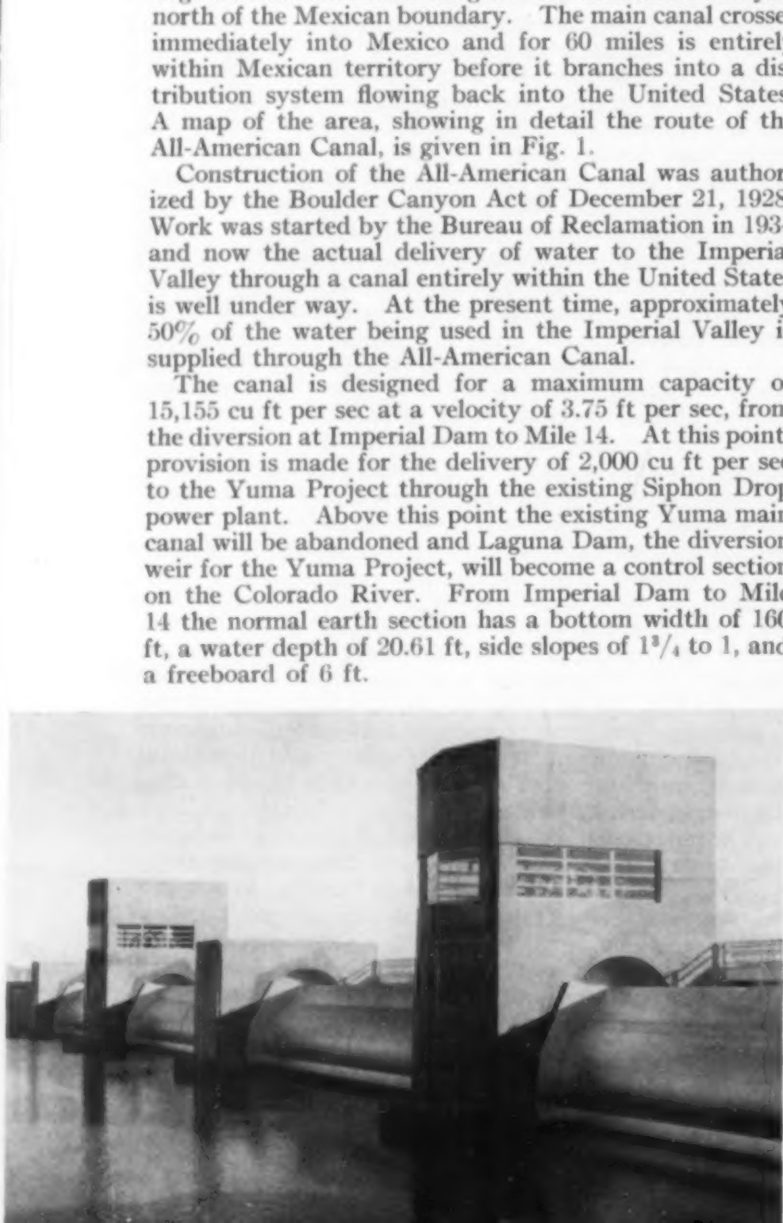
To a person who has never been there, it is hard to believe how fast water can disappear in the Southwest. In order to understand, one must have felt clothes dry on the line as fast as they were hung out, or seen water from a garden hose disappear into the earth. Anyone having had those experiences might well wonder at the scheme to send water through the sand hills section of the All-American Canal. Within the bounds of reason the question arises whether any water could be delivered at the outlet end of the canal. Actually water is delivered and with losses on a surprisingly small scale. This paper was originally delivered by Mr. Foster before the Irrigation Division at the Society's San Diego Convention.

Primarily, the reason for the construction of the All-American Canal was to provide a dependable water supply carried through a canal system entirely within the United States. Other major considerations were the need of an enlarged capacity to provide for additional area development in the Imperial and Coachella valleys, and especially the need for works to eliminate the costly dredging and maintenance operations required on the existing system due to the enormous silt load. In addition, the growing demand for power in the Imperial Valley made the prospect of developing hydroelectric power at drops on the All-American Canal an important consideration.

The existing system of the Imperial Irrigation District begins at Rockwood heading on the Colorado River just north of the Mexican boundary. The main canal crosses immediately into Mexico and for 60 miles is entirely within Mexican territory before it branches into a distribution system flowing back into the United States. A map of the area, showing in detail the route of the All-American Canal, is given in Fig. 1.

Construction of the All-American Canal was authorized by the Boulder Canyon Act of December 21, 1928. Work was started by the Bureau of Reclamation in 1934 and now the actual delivery of water to the Imperial Valley through a canal entirely within the United States is well under way. At the present time, approximately 50% of the water being used in the Imperial Valley is supplied through the All-American Canal.

The canal is designed for a maximum capacity of 15,155 cu ft per sec at a velocity of 3.75 ft per sec, from the diversion at Imperial Dam to Mile 14. At this point, provision is made for the delivery of 2,000 cu ft per sec to the Yuma Project through the existing Siphon Drop power plant. Above this point the existing Yuma main canal will be abandoned and Laguna Dam, the diversion weir for the Yuma Project, will become a control section on the Colorado River. From Imperial Dam to Mile 14 the normal earth section has a bottom width of 160 ft, a water depth of 20.61 ft, side slopes of $1^3/_4$ to 1, and a freeboard of 6 ft.



75-Ft Roller Gates on Imperial Dam Control Headworks of All-American Canal

Below Siphon Drop the canal section is reduced as successive diversions are provided for, until at the West Side Main Canal a capacity of 2,600 cu ft per sec is carried in a canal section having a bottom width of 60 ft, a water depth of 11.27 ft, side slopes of $1^1/_2$ to 1, and a velocity of 3 ft per sec.

Near Mile 20 is the Pilot Knob check and wasteway, one of the principal points of control on the canal. Through this wasteway, the entire flow of the All-American Canal can be diverted into the present settling basin of the Imperial Canal between the Rockwood Heading and Hanlon Gates. By closing the Hanlon Gates, waste water can be turned back through the gates at Rockwood Heading into the Colorado River.

Just west of the sand hills, at about Mile 35, is the Coachella Canal turnout and Drop No. 1. At this point 2,500 cu ft per sec will be delivered to the Coachella Branch Canal. This canal when completed will be 130 miles long and will supply a portion of the East Mesa and the entire Coachella Valley at the north end of the Salton Sea.

In all, there are five drops, four of which may be used for the generation of power. At Drops 3 and 4, power plants have already been constructed, and power is now being generated by the Imperial Irrigation District.

The infrequent, but sometimes very heavy, runoff from the hills and mesa above Pilot Knob necessitated the construction of a number of storm drainage structures. The canal is carried under the four largest washes in siphons. Six overchutes carry smaller washes over the canal, and the smallest washes are carried into the canal by numerous drainage inlet structures.

Other important structures along the canal include three steel and concrete bridges on highway U.S. 80, two railroad bridges, a concrete-lined section on earth fill across the Alamo River, a double-barreled, 15-ft 6-in. steel-pipe crossing over the New River, and many checks, turnouts, road siphons, and bridges.

For about $1^3/_4$ miles above Laguna Dam, the canal follows the toe of the mountains. The left canal bank was built on the flood plain of the Colorado River. Throughout most of this distance, the canal bottom was at or above the natural ground surface. In order to insure safety, the lower bank was built of selected material, compacted in 6-in. layers, with a rock fill on the outer slope and a row of 20- to 30-ft Wakefield sheet piling to prevent piping or sandboils. In effect, this stretch of embankment is an earth dam 8,490 ft long and 26.6 ft high.

At many points between Imperial Dam and Pilot Knob, and at two sections below the latter point, where the canal is built along the edge of the mesa above the river valley, short sections of compacted earth lining were placed on the inside slope of the lower embankment. This was built of selected material, sprinkled and rolled

as in the embankment above Laguna Dam. The maximum width of the lining is 24 ft at bottom grade, and 18.6 ft at the top, which is 1 ft above the highest water surface. The toe of the lining was carried a minimum of 5 ft below bottom grade and in some cases as much as 20 ft below when very porous material was encountered. The primary purpose of this lining is to insure stability of the embankment in sections of shallow cut or where porous or stratified material was encountered. However, this type of construction also accomplished some reduction in seepage losses.

In January, February, and March 1939, the first test run of water in the All-American Canal was made. The quantity diverted from the Colorado River at Imperial Dam during this run varied from 130 to 609 cu ft per sec and the depth in the canal from 2 to 4 ft. No water was allowed to flow beyond Pilot Knob Check, approximately 20.6 miles downstream from Imperial Dam, because of construction work at Coachella Turnout.

The primary purpose of the test was to determine the effect of seepage on the water table in the irrigated lands adjacent to the canal in the Reservation Division of the Yuma Project, rather than to make a quantitative determination of seepage losses. Test-well measurements made at weekly intervals during this period showed a rise of from 1 to 4 ft in the water table in the Reservation Division. Part of this rise doubtless was due to the fact that the Colorado River was higher (about 25,000 cu ft per sec) during the period of the test than it had been previously. On the other hand, the water was not in the canal for a sufficient length of time to permit the water table to become well established, so that it is probable that a further rise in the ground water would have occurred had the run extended over a longer period. The test run demonstrated conclusively that measures should be taken to prevent seepage damage to Reservation Division lands before the canal was placed in continuous operation.

Studies were therefore undertaken to determine feasible methods of preventing such damage from seepage, and it was decided to place a blanket of clay on the bottom and inside slopes of the canal. Since the existing water table in the Reservation Division was so high that even the small amount of seepage that could be expected through the clay blanket would be objectionable, it was decided also to provide a system of intercepting drains along the upper boundary of the irrigated lands.

Except for about a half mile of clayey material, the 13-mile stretch of the canal along the upper boundary of the Reservation Division is mostly located through porous sands, and compacted

Imperial Dam, Roller Gates, and Desilting Works from the Air

earth lining had been placed on about one-third of the lower side slope in this section. It was decided to cover the bottom of the canal with clay over a length of about 15 miles, extending a mile beyond the limits of the cultivated land at each end. The original plan contemplated a clay blanket on the side slopes only through the most porous sections. However, this plan was later revised to include blanketing these slopes throughout the 13-mile stretch adjacent to the Reservation Division, except where they had previously been lined with compacted earth, and in the short section in clayey material.

Material for the blanket was obtained from two borrow-pit areas, one composed of the spoil banks from the excavation of the canal through the half-mile clayey section mentioned previously, and the other about a mile north of the canal near the downstream end of the clay blanket.

The clay material was spread over the bottom of the canal in a layer 4 in. thick and then mixed with an equal quantity of native material by disking. After the clay and sand had been thoroughly mixed, the material was moistened by sprinkling and rolled with a smooth tractor-drawn roller. The resulting compacted

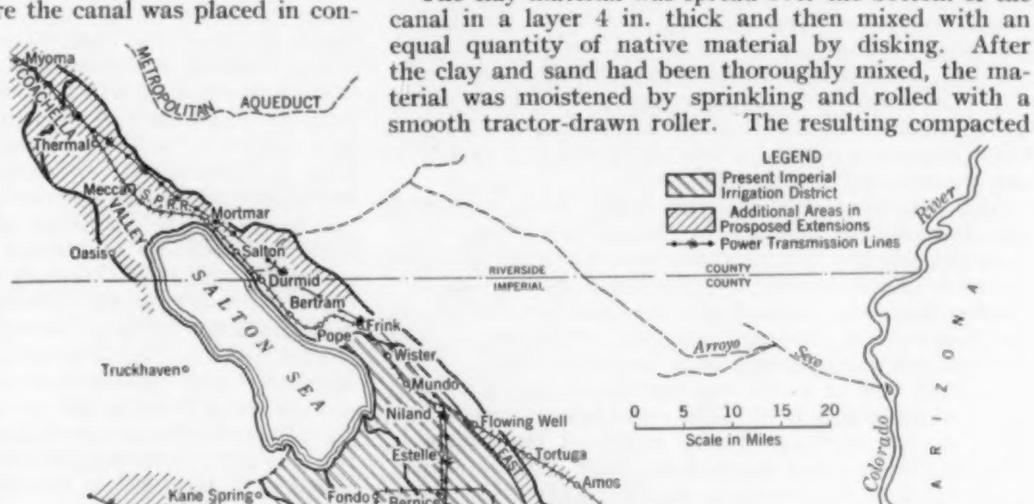
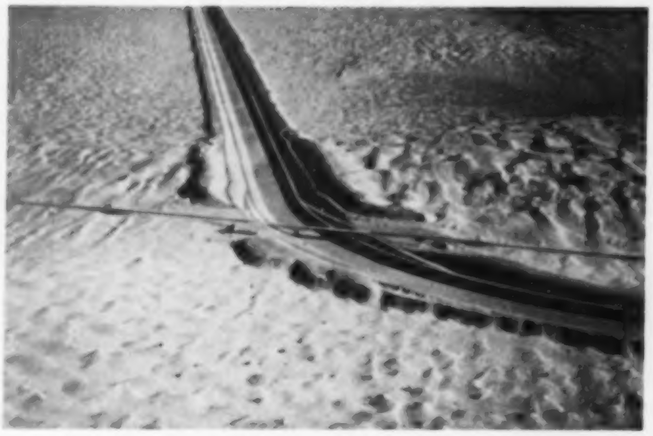


Fig. 1. Location Map of All-American Canal



584-FT BRIDGE SPANS CANAL IN SAND HILLS SECTION

layer formed a dense, relatively impervious blanket, which should greatly reduce the rate of seepage through the sandy canal bottom.

Material for the 6-in. clay blanket on the side slopes was dumped along the toes of the slopes, and then cast into place by a dragline and dressed down. No attempt was made to compact the side-slope blanket. In the upstream portion of the blanket, the side slopes were covered with clay to the height of the ultimate maximum water surface. Since the canal will not be operated at full capacity for a number of years, it was decided to place the remainder of the side-slope blanket only to a height of 12 ft, with the expectation of extending it to ultimate water height at some future date.

The work of placing the clay blanket was started in February 1940, and finished in September of the same year. A total of approximately 200,000 cu yd of clay was placed. Ninety per cent of the work was done by contract, and the remainder by government forces.

The intercepting drainage program north of the Yuma Canal involved the construction of 7 miles of new open drains averaging 8 ft in bottom width and 11 ft in depth, and the excavation of 416,000 cu yd.

Although emergency use was made of the upstream and downstream portions of the All-American Canal after the first test run, no continuous diversion from the Colorado River could be attempted until the clay blanket had been finished and the drainage program in the Reservation Division was well under way. And this was not accomplished until September 1940.

A small flow of water was introduced into the canal on September 17, 1940. The quantity diverted from the river was very gradually increased, and early in October the flow had reached the East Highline Canal. On October 12, a celebration was held at the East Highline Canal Turnout, commemorating the first delivery of Colorado River water carried entirely through the All-American Canal to the Imperial Valley. After the celebration, the flow was gradually increased until in November 1940, the East Highline Canal, largest of the three main canals in the Imperial Valley, was supplied completely from the All-American Canal. Generation of power at the hydroelectric plants built by the Imperial Irrigation District at Drops 2 and 4 was started in February 1941, and has since been practically continuous.

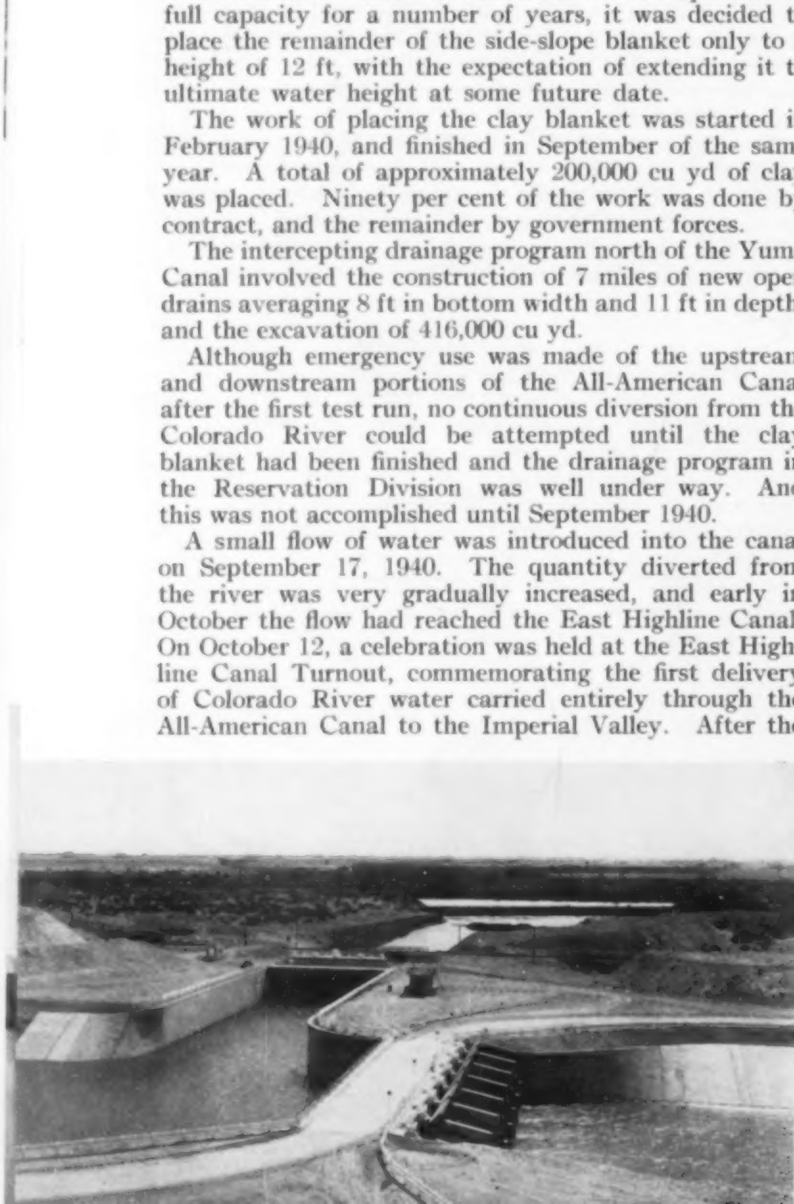
CONSTRUCTION OF COMPACTED EARTH LINING CONTROLS SEEPAGE

During March 1941, the plug, or unexcavated section in the All-American Canal, across which the Old East Highline Canal had flowed during the construction of the All-American Canal, was removed. Shortly afterward a similar plug, used to carry several smaller canals across the All-American Canal at Allison Heading, was likewise removed, and the connections between these canals and the All-American Canal were made. Delivery of water to the canals at Allison Heading was begun on April 10, 1941. On June 17, 1941, a third reach of the All-American Canal was put into use when water began flowing into the Central Main Canal. Since June 20, a gradually increasing quantity of water has been carried to the West Side Main Canal. Thus water from the Colorado River is now flowing through the entire length of the All-American Canal, and over half of the irrigated land in Imperial Valley is receiving its water by this route. The flow will continue to increase gradually, and it is expected that by early in 1942 all the water used by the California portion of Imperial Valley will be delivered through the new system.

Test-well readings during this 9 months' period of operation have shown that with few exceptions the ground-water level in the area below the All-American Canal is as low as, or lower than, it was before the initial run of water. It is therefore evident that the protection afforded these lands by the clay blanket and the intercepting drains is adequate.

No fixed program for increasing the quantity and depth of flow has been followed. In general, the depth has been raised as slowly as operating conditions would permit. The portion of the canal upstream from Drop No. 2 has not yet been filled to full depth. Most of the sections between Drop No. 2 and the East Highline Turnout have been filled at times almost to full depth, but the water level in these sections has always been raised slowly. The stretch between the East Highline Turnout and Allison Heading was filled to approximately full depth rather quickly to avoid delay in the delivery of water.

The canal is patrolled at regular intervals, and an operating telephone line extends over the full length. This enables patrolmen to report promptly to Imperial



PILOT KNOB CHECK AND WASTEWAY WITH COLORADO RIVER IN BACKGROUND

Dam such matters as gage readings at various points along the canal, changes in the demand for water, bank conditions, and any other observations that might affect operation. Eventually, constant water-surface elevations will be maintained above the power drops by automatically operated gates. The amount of water flowing into the canal is closely controlled at Imperial Dam to conform with variations in demand, and this control is supplemented by varying the amount of storage in the canal above the check gates of Drop No. 1.

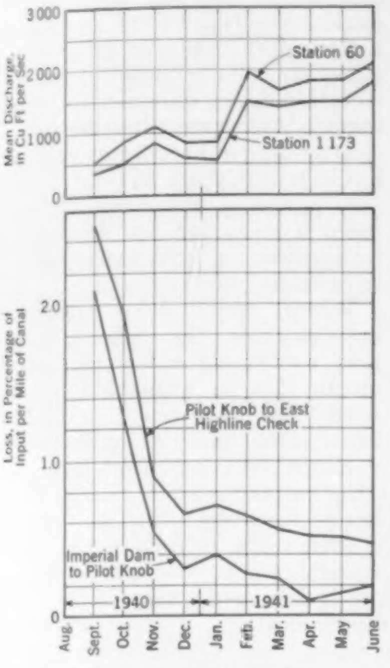


Fig. 2. Seepage Losses in All-American Canal

To determine the discharge at various points along the canal, several metering stations have been established. Three of these are operated by the U.S. Geological Survey in cooperation with the Bureau of Reclamation. The data obtained have been carefully studied and estimates have been made of conveyance losses in the various sections of the canal. Losses from the beginning of operations, September 1940, to June 1941 are plotted in Fig. 2, in which the loss between Imperial Dam and Pilot Knob (a distance of 19.75 miles) is given as percentage of discharge at Sta. 60, per mile of canal. The loss between Pilot Knob and East Highline Check (a distance of 35.62 miles) is given as percentage of discharge at Sta. 1173, per mile of canal.

As expected, conveyance losses during the first months of operation were rather high. As the dry banks became saturated and the ground-water table was established, these losses gradually decreased. There has been some temporary increase in loss with each increase in discharge, but when the discharge has been held fairly constant over a period of time, the loss has again decreased.

High seepage losses were to be expected in the early period of operation because of the large proportion of wetted surface. The capacity of the canal below Imperial Dam is 15,155 cu ft per sec, while the maximum discharge to date has been about 2,500 cu ft per sec. Since the bottom width in this section is 160 ft, the cross-sectional area in use is disproportionally wide and shallow. In the lower reaches, above the power houses at Drops 3 and 4, and in the sections where deliveries are made to the turnouts, it has been necessary to check the water up to the normal elevation for the full capacity. This of course likewise increases seepage losses out of proportion to discharge.

Considerable money has been invested in a desilting works at Imperial Dam to insure the removal of the coarser material from the canal system. So far it has been unnecessary to use the desilting works. In fact, prior to the recent increase in the discharge from Boulder Dam, practically clear water has been coming through

Drifting Sands So Far Have Not Damaged Canal
Maximum Drift Shown on Near Bank

Imperial Reservoir into the canal. An increase in the concentration of fine silt, smaller than 0.05 mm, was considered very desirable to aid in sealing the canal.

To accelerate the process of securing fines for sealing purposes, the operating level of the reservoir was lowered in November 1940 from the normal El. 179.5 to El. 174.5. The effect has been to move deposits from the upper part of the reservoir down toward Imperial Dam and to channelize the river through the reservoir. With the increased flow in the Colorado River since May 1941, this process has been accelerated, and by the middle of June considerable deposits of sand were visible immediately above Imperial Dam. Some increase was also apparent in the suspended sediment samples taken at Imperial Dam sluiceway and at Sta. 60 on the canal.

It is computed that at the present time about 540 tons of silt is carried into the canal daily, of which 60% drops out in the first 54 miles. Mechanical analysis of the material carried in suspension indicates that 92% is smaller than 0.05 mm, and 50% is smaller than 0.005 mm. Material of this character will contribute considerably to a reduction in seepage losses.

Since the completion of the excavation through the sand hills in September 1937, very little sand has drifted into the canal section. One of the accompanying photographs shows the lower portion of the deepest cut in the sand hills, where the maximum movement of drifting sand has occurred. This is the only point where such drifting has been appreciable. Although some sand has drifted over the berms in this cut, very little has been deposited below maximum water level. It probably will be many years before it is necessary to remove wind-blown sand from the canal.

The All-American Canal system is part of the Boulder Canyon Project of the U.S. Bureau of Reclamation. John C. Page is Commissioner of the Bureau and S. O. Harper is chief engineer. All designs were prepared under the supervision of J. L. Savage, chief designing engineer. The Construction Engineer also acknowledges the valuable aid given by Engineer Gordon Manly and Associate Engineer Phillip Noble, of the All-American Canal staff, in the preparation of this article.

Deepest Cut (100 Ft) in Sand Hills Section Was Accomplished by Six Dragline Operations

Conveyance Losses in Irrigation Canals

By E. B. Debler, M. Am. Soc. C.E.
Hydraulic Engineer, U.S. Bureau of Reclamation, Denver, Colo.

In the arid lands of the West, where irrigation provides the means of livelihood for literally millions of people, it is self-evident that water has a monetary value. Little attention, however, is often paid to the escape of this valuable fluid in seepage from delivery and distribution systems. Yet such losses are not only costly in terms of dollars, they also may ruin productive land through a rise in the ground-water table or in other ways. In this paper, from a session of the Irrigation Division at the San Diego Convention, Mr. Debler draws attention to the importance of such water losses and to the need of taking definite steps of practical usefulness to collect and correlate data on this neglected subject.

Canal losses have largely come to be regarded as something that we have with us always. In some localities water values are so high as to make a reduction of such losses financially attractive, and in many isolated instances their elimination is imperative to prevent canal breaks. However, the average canal is still a run-of-the-mine production, and little thought is given to the significance of losses and little attention is directed to their control.

In a paper on the "Use of Water on Federal Irrigation Projects" (Transactions, Am. Soc. C.E., Vol. 94, 1930, page 1195), the writer presented a summary of records of the Bureau of Reclamation which showed distribution system losses ranging from 13% to 48% on the average individual project. The apparently low losses on some projects are due to special conditions which preclude determination of the actual loss. Much data on distribution losses are also found in Bulletin No. 6 of the California Department of Public Works, published in 1923. Except in rare instances, the loss of water in earth canal systems of ordinary construction may be expected to range from 20% to 50% of diversions. Losses from systems on which all or part of the canals are lined in some way, or which consist of pipe lines, may range from a few per cent of the diversions to magnitudes fully equaling earth systems, depending on the extent and character of the improvements and the adequacy of maintenance.

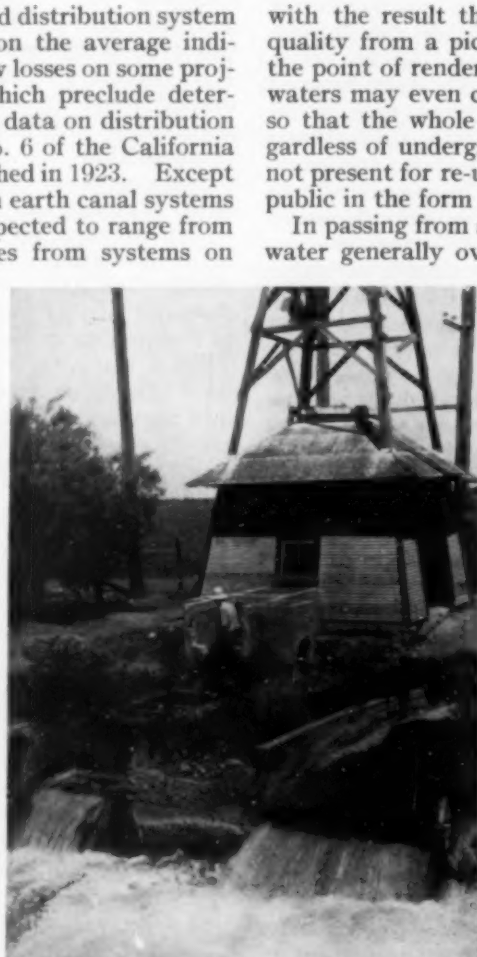
The menace to canals from escaping waters, while of primary interest to the operator, is seldom of greatest importance when the entire field is considered. First of all, canal capacities must be provided to cover distribution losses in addition to necessary deliveries to the land, often at heavy cost. With systems having storage reserves, the water lost has been provided at considerable expense. With a capital cost of $50 per acre-ft of annual yield, an estimate probably below the average at this time, a distribution loss of 40% is equivalent to an increase of $20 per acre-ft in storage costs.

While losses cannot be eliminated, a partial reduction may be within reach at a cost much less than the resulting saving in storage costs. Where storage possibilities are sharply limited, a reduction in losses will enable extension of the area served without increasing the canal capacity, in some cases with a marked reduction in project construction costs per acre of land and a corresponding reduction in annual costs. Widespread transmission of electric power at decreasing rates has in recent years fostered numerous pumping projects. In such cases a reduction in distribution losses means a perpetual reduction in operating costs.

Where underground conditions are favorable, the escaping waters may eventually reach the parent stream and be available for re-use with little impairment in quality. More often, however, underground conditions are not entirely favorable, with the result that the seeping waters deteriorate in quality from a pick-up of dissolved solids, at times to the point of rendering them unfit for further use. Such waters may even contaminate otherwise usable streams so that the whole flow is rendered unfit for use. Regardless of underground conditions, if opportunities are not present for re-use, then there is a definite loss to the public in the form of curtailed irrigation development.

In passing from a canal to a major stream, the seeping water generally overtaxes the carrying capacity of the soils, subsoils, and underlying rocks, forcing ground waters to the surface or near enough thereto so that the lack of carrying capacity can be overcome by increased soil evaporation and plant use. The attendant results produce loss of water and productivity in varying degrees, unsightly seeped areas which detract from property values, and damage to roads and other improvements. Artificial drainage may provide a palliative, but only at a material cost for construction and maintenance, which usually falls on the impaired area. The escaping waters collect in tributary streams that are seldom adapted to the carrying of perennial flows, with resulting erosion damage to banks and structures.

Lastly, a reduction in distribution losses and elimination of seeped areas are needed in view of the continuous campaign for reduced use of water by the irrigator. Conservation of water by the project itself will provide a better lesson and incentive for individual efforts toward water conservation than costly educational programs that must be repeated through the years.



Waste Water Being Returned to a Lateral for Re-Use on the Salt River Project
Surface Surplus Flowing in at Right and Sub-Surface Water Being Pumped in at Left

There are still some canals without upper banks to confine the water to the canal prism. This condition often entails heavy losses through porous areas and in addition promotes excessive evaporation from water surfaces and increased use by water-loving plants. These difficulties may be eliminated by building the needed banks. Elimination of trees and other vegetation along the canal is often desirable. The resulting saving in water will not be as great as popularly thought, but the attendant elimination of ground passages formed by rotting roots and burrowing animals and other living things will materially reduce percolation.

METHODS OF REDUCING WATER LOSSES

Reduction of water losses from canal prisms must be secured either by means of a skin of impervious material or treatment of the underlying canal material to reduce percolation. Skin treatment with concrete, clay, and bituminous products is universal; but specific information on losses and maintenance costs with such surfaces is scanty, and little even of that is available to the public. Specific records of experience with one or another type of lining abound, but these have not been correlated for a comparison of results as a guide to well-founded practice. Inquiries for information develop an astounding difference of opinion on the relative efficacy of linings and their maintenance costs through the years.

Skin treatment by means of bentonite and other materials of a similar type is as yet in a stage so experimental as to permit no fixed opinions. Possibly a comprehensive tabulation of results, together with observation of experiments under way and proposed for the immediate future, will yield an answer.

Compaction of high canal banks to secure stability has been employed for years, but the extension of this practice to canal systems as a whole for the purpose of reducing losses has been given little consideration. This method appears to hold exceptional possibilities for the improvement of agricultural conditions, possibly with material advantages in construction and operating costs. It must be realized, however, that the planner and the constructor are seldom the same person and that their viewpoints are widely different, making it difficult to accomplish the desired results. To be effective such treatment must apply to operation as well as design and construction.

Treatment of canal surfaces by impregnation with chemicals and passage-closing materials has received some attention and may deserve more.

The foundation of all research on loss of water rests on the measurement of actual losses, yet there is almost universal opposition to the expenditure of the necessary operating funds for that purpose, especially where the control of operation rests with the irrigators. No doubt this is due in part to the fact that such expenditures bring no immediate benefits, but in the main it arises from a lack of appreciation of the importance of reducing losses. Many projects are without measuring devices of any kind, while others make only perfunctory measurements with defective equipment.

WATER MASTER MEASURING FLOW IN A LATERAL
This Gage, Manufactured by the Salt River Water Users Association and Developed on the Project, Has Been Widely Adopted

PROGRAM TO INVESTIGATE CANAL LOSSES

The situation would appear to justify the extensive adoption of measures to reduce water distribution losses.

The limited specific information on this subject and the lack of an assembly of such data as do exist, precludes the application of past experience to these situations. The Executive Committee of the Irrigation Division of the Society is sponsoring a committee to arrange for the collection, analysis, and presentation in readily usable form of data on canal losses, and the means and costs for their reduction, including data on continuing expenses for maintenance.

Conveyance losses are so important and yet so little appreciated that any efforts to enlarge our knowledge about them are well worth considering as a valuable contribution to engineering.

(*Note: Society members desiring to participate in the committee work outlined, are urged to communicate with the writer of this article.*)

CONCRETE-LINED CANAL AND TUNNEL PORTAL OF MAIN KLAMATH CANAL, OREGON

TRIMMING MACHINE SHAPING A SECTION OF CONTRA COSTA CANAL, CENTRAL VALLEY PROJECT, CALIFORNIA

Theodore Dehone Judah—Railroad Pioneer

Part I. Concept of Conquest

By John D. Galloway, Hon. M. Am. Soc. C.E.
Consulting Engineer, Berkeley, Calif.

On the green lawn in front of the Station Building of the Southern Pacific Railroad, in the City of Sacramento, the capital of California, may be seen one of the few monuments erected in America to the memory of an engineer. Most fittingly the monument is made up of massive granite boulders from the high Sierras, the snowy summits of which may be seen on a clear day from the capital city. It bears in enduring bronze the medallion of the engineer, together with a brief statement of his services in organizing and locating the Central Pacific system. This monument was erected to preserve the memory of one of the most gifted engineers of the previous century, Theodore Dehone Judah. But one other American railroad engineer seems to have been thus honored—John F. Stevens, whose statue stands on Marias Pass where the Great Northern Railroad crosses the summit of the Rocky Mountains. On the abandoned line of the Union Pacific over the Rocky Mountains, at the Sherman summit, over 8,000 ft above sea level, a huge granite pyramid has long stood recording the services of Oakes and Oliver Ames, the Boston financiers who made the railroad possible. The monument should have been dedicated to Grenville M. Dodge, the great chief engineer who located the line through Sherman Pass.

Those who today enjoy the luxury of air-conditioned transcontinental railroad service little realize the hardships of the early builders who made this service possible. Among the epics of the West is the story of the building of the Central Pacific line, still in active use. One man, Theodore Judah, envisioned the great possibilities of this route, and "Civil Engineering" is here privileged to present the story of his life, in line with its policy of publicizing major engineering accomplishments and personalities. Mr. Galloway here sets forth Judah's apprenticeship years in the East and the West, his dream of the Sierra crossing, and his realization of its formidable difficulties. The story of his final triumph against odds of physical and human nature will be told in a later issue.

Almost two-thirds of a century elapsed after Judah left the scene of his labors in the mountains of California before his name was perpetuated by the memorial. The trains of the great railroad have passed and repassed over the line he located countless times since his death, and they bid fair to do so as far into the future as one may see. Yet few recall his name or services.

It is a pleasure to turn back to the middle of the nineteenth century, when a pioneer society allowed the engineer great freedom of initiative and accomplishment. The work of Judah and of the other able men who projected and carried out the building of the Union and Central Pacific railroads in the decades of 1850 and 1860 was done as the culminating effort in the movement of the American people from the Atlantic to the Pacific. That movement took place because able men were allowed to come to the front and lead in the great enterprise. It is altogether fitting to remind the present generation of one in the long line of brilliant engineers who built the railroads of the country. The list of such men is an honorable one and deserves to be recorded for the benefit and inspiration of those who come after.

The claim of Theodore Judah for a place in the record rests on a number of counts—on qualities and accomplishments not ordinarily found in engineers, especially not in a single person. As a young man engaged in railroad work, he was a dreamer who envisioned the great project of a railroad crossing deserts and mountains to connect the East and West. As a promoter he was subjected to the slurs and backbiting of his contemporaries—the crowd ever unwilling to recognize a great man among them and resisting his efforts to "lead them a little from the ruck of things." He projected a railroad across a great range of granite mountains, snow covered in winter and so high and difficult that their conquest had never before been considered or attempted. He departed from established procedure in locating the line on a ridge of the mountains and not in a canyon following a river. As an organizer he formed the railroad company and enlisted the services and abilities of other men who carried out the project long after he was dead. Finally, as a clear exponent of the project, Judah was able to convince the wrangling men of the nation's Congress that here at last, after years of talking, was a feasible project.

Before he died, the work he had dreamed of was well on its way to realization. The general route of the road had been determined, the necessary laws passed, the financial

> THAT THE WEST
> MAY REMEMBER
> THEODORE DEHONE JUDAH,
> PIONEER, CIVIL ENGINEER AND TIRELESS ADVOCATE OF A GREAT TRANSCONTINENTAL RAILROAD
> —AMERICA'S FIRST—
> THIS MONUMENT WAS ERECTED BY THE MEN AND WOMEN OF THE SOUTHERN PACIFIC COMPANY, WHO, IN 1930, WERE CARRYING ON THE WORK HE BEGAN IN 1860. HE CONVINCED FOUR SACRAMENTO MERCHANTS THAT HIS PLAN WAS PRACTICABLE AND ENLISTED THEIR HELP. GROUND WAS BROKEN FOR THE RAILROAD JANUARY 8, 1863, AT THE FOOT OF K STREET, NEARBY.
> JUDAH DIED NOVEMBER 2, 1863.
> THE ROAD WAS BUILT PAST THE SITE OF THIS MONUMENT, OVER THE LOFTY SIERRA—ALONG THE LINE OF JUDAH'S SURVEY—TO A JUNCTION WITH THE UNION PACIFIC AT PROMONTORY, UTAH, WHERE ON MAY 10, 1869, THE "LAST SPIKE" WAS DRIVEN.

Inscription Appearing on Judah Memorial at Sacramento, Illustrated on Page of Special Interest

This Memorial Project was Initiated and Carried Through by W. H. Kirkbride, Chief Engineer of the Southern Pacific Company

problems partly solved, the rails laid on a short stretch of the line—and trains were running! An untimely illness ended his career, but his clear vision in locating the western end of the first transcontinental railroad entitles him to lasting recognition. No one has challenged his work; many have voiced approval; and no essential changes have been made in the line that he located. Other transcontinental railroads have been built, but to the builders of the first one, in the face of the unprecedented difficulties that confronted them, must go the greater credit that is theirs.

Theodore Dehone Judah was born at Bridgeport, Conn., on March 4, 1826. When he died in New York on November 2, 1863, he lacked four months of being thirty-eight years of age. Into those brief years he packed more than a normal lifetime of accomplishment. His father, an Episcopal clergyman, had three sons. Besides Theodore, there were Henry M. Judah, who became a brigadier general in the Civil War, and Charles D. Judah, who went to California in 1849 and became a member of the law firm of Hackett and Judah.

Theodore Dehone Judah, Seer and First Chief Engineer of the Central Pacific Railroad

While Theodore was a boy, the family moved to Troy, N.Y. There was some thought of entering the youth in the Navy, but he was attracted to engineering and was sent instead to Rensselaer Polytechnic Institute, from which he graduated. Out of school, his first work was on the Troy and Schenectady Railroad, and he continued in railroad work until his death, the only exception being his position as construction engineer on a section of the Erie Canal between Jordan and Seneca, N.Y. His railroad work included service on the New Haven, Hartford and Springfield Railroad, the Connecticut River Railway, and the Buffalo and New York Railway, now a part of the Erie system. He also located and built the Niagara Gorge Railroad, then considered a difficult piece of construction. At one time he supervised the construction of a bridge at Vergennes, Vt.

At Greenfield, Mass., Judah met Anna Ferona Pierce, the daughter of a local merchant, and married her on May 10, 1847. That young lady, like many another engineer's wife, followed her wandering husband to the distant and unknown land of California. After his death she wrote a description of his work and defended him against the unjust slanders which the enemies of his project directed against him to serve their own interests.

In 1852 a group of Californians, among them the young Capt. William Tecumseh Sherman, were projecting a railroad eastward from Sacramento towards the foothills of the Sierra Nevada and also northward along the range in order to secure the trade of the mining regions in the mountains beyond. The president of the road, on the recommendation of Governor Horatio Seymour of New York and his brother, Silas Seymour, a railroad engineer of prominence, sought Judah's services as chief engineer. Judah telegraphed his wife: "Be home tonight, we sail for California April second." This was in March 1854, while he was engaged on the Buffalo and New York Railway. Mrs. Judah described his homecoming thus: "You can imagine my consternation on his arrival that night. It was all laid out in these words: 'Anna, I am going to California to be the pioneer railroad engineer of the Pacific Coast. It is my opportunity, although I have so much here.' He had always talked, read, and studied the problem of a continental railway and would say: 'It will be built and I am going to have something to do with it.'"

Judah Arrives in California

The young couple sailed by the Nicaragua route, and by May 1854 Judah was at work on his surveys for the Sacramento Railroad. It was to be built due eastward from Sacramento to Folsom, a distance of about 25 miles. A contract was awarded in November 1854; grading commenced in April 1855; the first rail was laid on August 9 of that year; and the line was in operation by February of the next. All the work was done under the charge of Judah although he left shortly before its completion. This was the first railroad to operate in California. Later, as mining fell off, traffic declined, and the road was afterwards sold to the Central Pacific. The cost had been about $60,000 per mile.

This was the period when railroad projects were being proposed in every direction in the central valley of California. And for the next three years, 1856–1859, Judah was connected with several of these. However, he never lost sight of the main problem, one of much greater magnitude, the railroad across the country to the Missouri

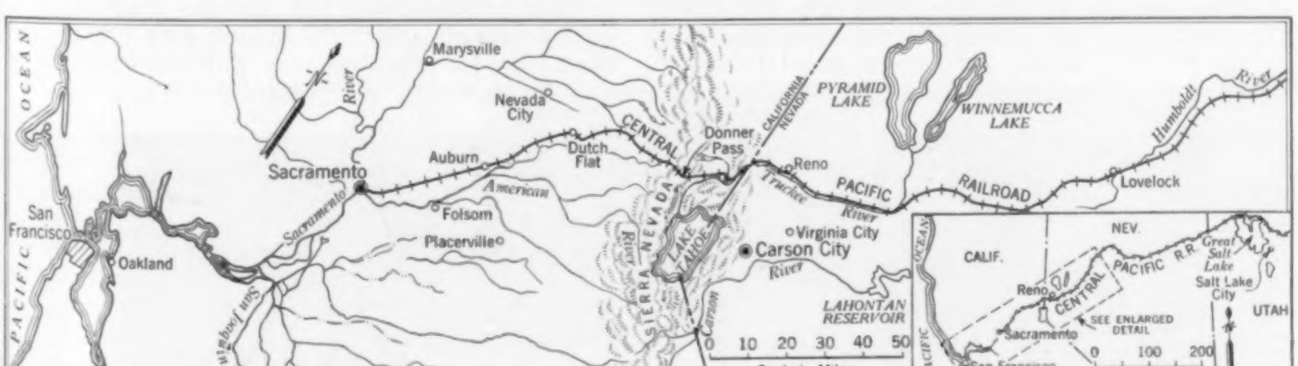


Fig. 1. Map of Western End of Central Pacific Railroad

Eastward of This Section It Follows the Humboldt River Almost Into Utah—See Insert

River. In this connection Mrs. Judah writes:

"Everything he did from the time he went to California to the day of his death was for the great continental Pacific Railway. Time, money, brains, strength, body and soul were absorbed. It was the burden of his thought day and night, largely of his conversation, till it used to be said 'Judah's Pacific Railroad crazy,' and I would say: 'Theodore, those people don't care' or 'You give your thunder away.' He'd laugh and say: 'But we must keep the ball rolling.'"

It was his persistence in advocating the railroad that finally won the day but at times he was a great nuisance to his acquaintances by his constant discussion of the project.

It will not be out of order at this point to examine for a moment the problems to be faced in building a railroad across the country. Such a road had been talked of for many years. On the eastern end the problem had been solved by the men of the Union Pacific, among whom Grenville M. Dodge, one time Honorary Member of the Society, is perhaps the best known. The chief barriers in the way of a road from Omaha to Sacramento were several mountain ranges and over a thousand miles of desert. The California end of the line was to be at Sacramento, capital of the state. A later extension to San Francisco was projected.

AT THE DEDICATION OF THE JUDAH MONUMENT, ON THE GROUNDS OF THE SOUTHERN PACIFIC STATION, SACRAMENTO

This Was Arranged to Occur During the Spring Meeting of the Society, April 26, 1930. John F. Coleman, Then President of the Society, Stands at the Left. Next to Him Is W. H. Kirkbride, M. Am. Soc. C.E., Main Speaker at the Exercises. Unveiling of the Completed Monument Occurred in February 1931

Eastward of the great valley of California lies the Sierra Nevada, a mountain barrier about 400 miles long. Where the Central Pacific was built the peaks vary from 8,000 to 11,000 ft in height and the passes from 7,000 ft up. The mountains are a tilted fault block, with a long sloping rise of 7,000 ft on the west from the Sacramento Valley to the passes and a sharp descent of about 3,000 ft on the east to the bordering valleys.

A feature of this mountain chain in the area under consideration is that it breaks into two ranges of about equal elevation, between which lies beautiful Lake Tahoe (Fig. 1). The lake and the surrounding watershed are drained by the Truckee River. This stream flows northward, then turns east, and after passing through the eastern range of the Sierra Nevada, the Truckee meadows, and the Virginia range, turns another right angle to flow northwestward into Pyramid Lake. Thus the Truckee River furnished a route eastward except for a barrier of some fifty miles between it and the Humboldt River, the only stream of Nevada that finds its way through the basin ranges of that state. To reach the Truckee River by a direct route from the west, it was necessary to cross the Sierra Nevada through a pass at an elevation of at least 7,000 ft.

Emigrant trails from the East had led down the Humboldt and across the Sierra Nevada either by Carson Pass at the headwaters of the Carson River (El. 8,650 ft) or across several passes at the headwaters of the Truckee River. The route was well known and the passes used were largely determined by the destination of the traveler. However, it will be recognized that a railroad must be built with practicable grades, a factor that, as a rule, was not of such great importance in the wagon travel of that day.

On the western slope of the Sierra Nevada the rivers have a steep pitch near the granite summits, and have incised deep canyons into the original plane of the mountains. For this reason, the usual method of locating a railroad along and up a river channel could not be followed. A line so located would be deep in a canyon when it reached the main mass of the mountains and would have to climb out on impossible grades, in order to cross the range. Tunnels might be a solution, but at the time under review they were out of the question.

It was indeed a formidable task that faced Judah as he came to tackle his greatest work, in conquering the western end of the transcontinental line. He had the vision of a great accomplishment; he had the training and experience to cope with difficult engineering problems; he had the will and the indomitable energy to prosecute the venture. What he could hardly anticipate—fortunately for him, perhaps—were the obstacles of personality, of human cupidity, that were to loom even larger in their effect than the mountain barriers themselves. The account of his success forms a separate story.

BREAKING GROUND FOR THE CENTRAL PACIFIC, JANUARY 8, 1863

Mural in the Southern Pacific Station at Sacramento Depicts Dedication Exercises on Nearby Levee of the Sacramento River

Motor-Vehicle Driver Behavior Studied by New Methods

By J. Trueman Thompson, M. Am. Soc. C.E.

Professor of Civil Engineering, Johns Hopkins University, Baltimore, Md.; Chief Highway Engineer, U.S. Public Roads Administration

For a number of years the U. S. Public Roads Administration has been studying the effect of driver behavior and vehicle characteristics on the movement of traffic. Prof. Thompson has been steadily connected with these developments and is therefore well fitted to give this bird's-eye view of the methods and apparatus developed. Because of the newness of the techniques, no final results can yet be given, but samples of data are presented, together with some very interesting early conclusions. Prof. Thompson gave his original paper before the joint session of the Highway and City Planning Divisions at the Society's Spring Meeting in Baltimore. In this first part he treats specifically of speeds, transverse placement, and passing. The second part, dealing with the performance of the vehicle itself, in hill climbing and braking, will appear in the next issue.

In 1937 the Public Roads Administration undertook a study of the hill-climbing ability of motor vehicles. Out of the devices used to detect the progressive positions of vehicles on grades there grew refined instrumentation and techniques which have subsequently been used not only for the original purposes but also for a study of driver behavior in several of its aspects. In the ensuing four years several discreet reports have appeared describing the progress being made in separate aspects of the work. It is the purpose here to draw these descriptions together in one place; to discuss their relationships and the related implications of their use; and to augment them with new material not hitherto published.

"Driver behavior" has to do with the movement of vehicles in traffic and, of course, with the driving habits of the operators who control them. How fast do they go? How far apart do they keep in the traffic lane? Where do they place themselves transversely? How long and how far do they run in the opposing traffic lanes when they overtake and pass? These are among the many questions which the studies attempt to answer.

There was recently developed in the laboratories of the U.S. Public Roads Administration an interesting and useful device for measuring the speed of vehicles. It has been described in detail elsewhere ("New Techniques in Driver Behavior Studies," by E. H. Holmes and S. E. Reymer, *Public Roads*, April 1940), but its operation will be briefly explained here because the equipment, or parts of it, is also used in some of the other studies to be discussed later.

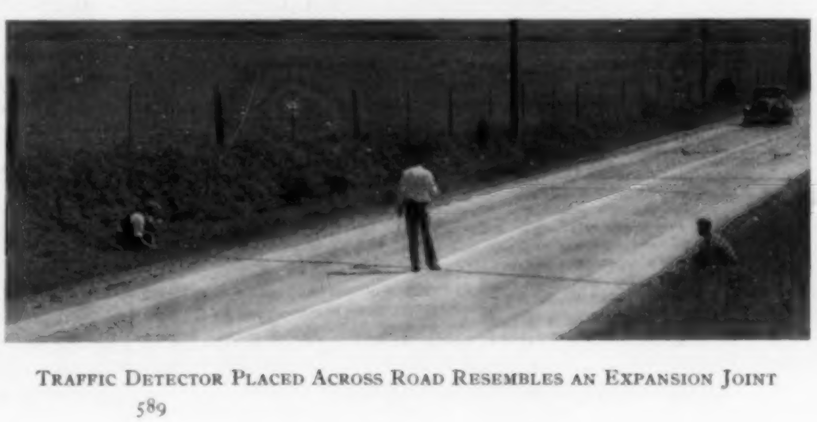
It consists of three parts—a pair of detectors, a metering instrument, and either a recorder or a counter. The detector employed in this and several other studies is simply a rubber tube about the size of a lead pencil which is stretched across the pavement and attached to stakes in the shoulder. At each end of the tube is a very sensitive pneumatic switch, which, with its component part, is shown in an accompanying photograph. These switches complete an electric circuit every time a wheel passes over the tube because the outside wheel increases the pressure of the air which is trapped in the tube between the wheel and the switch. The tube is plugged where it crosses the center line of the pavement so that air impulses originating in one traffic lane will affect only one of the switches. In this way the speed of vehicles in both lanes is recorded separately.

Two such detectors are laid on the road 24 ft apart. When a vehicle passes over the first of these it starts the speed meter; when it passes over the second, it stops it. This meter is too involved for detailed discussion here. It suffices to say that it depends on the principle of selectivity used in telephone dialing; it automatically signals the speed of the vehicle to the recorder or counter. When the individual speeds of vehicles must be known, as is generally the case, a recorder is employed with magnetically operated pens writing on a moving strip of paper.

Sometimes it is only necessary to discover how many vehicles in each of several speed groups pass over the detectors. When this is the case, the meter is connected to a bank of 20 counters, each of which is electrically connected to a group of contact points in the meter. Each counter therefore records the number of vehicles falling in each of a number of speed ranges. The frequency distribution of speeds can thus be seen in the counter windows after any interval of time.

Finally, it should be stated that the traffic detectors are quite inconspicuous and, as they look like extruded expansion joint material, it is believed that speeds are uninfluenced by their presence. The meter and recorders are housed in a truck which is off the road and concealed from approaching drivers.

There are many uses to which the speed measurements can be put. For example, we can learn the effect on speed of grades, of curvature, of spiralling and superelevation, and of surface type, especially as related to weather conditions. We can study, for comparable volumes of traffic, the effects of pavement widening, of lane additions, of shoulder improvement, and of the elimination of grade crossings, traffic lights, wayside concessions, and other conditions that are known to affect speed adversely. Of paramount importance are the fre-



Traffic Detector Placed Across Road Resembles an Expansion Joint

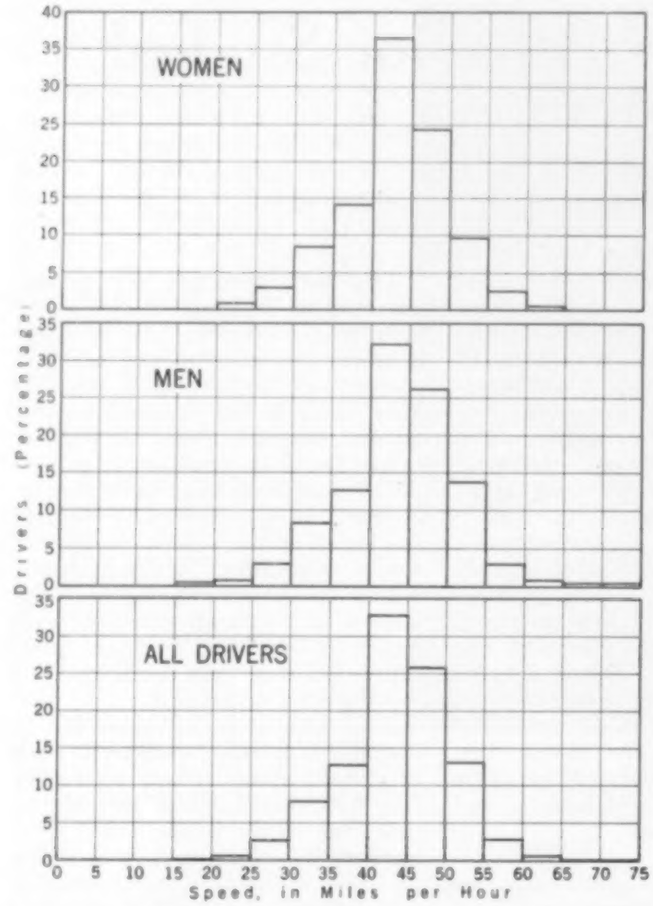


FIG. 1. FREQUENCY DISTRIBUTION OF PASSENGER-CAR SPEEDS

quency distribution diagrams of speed. These "speed patterns" are now being produced for a number of different road conditions in various parts of the country. A typical example is shown in Fig. 1.

A typical application to driver behavior in Connecticut was recently reported. ("A Study of Motor-Vehicle Drivers and Speed in Connecticut," by Harry R. deSilva, *Public Roads*, July 1940.) The observations were all made on week days between 10:00 a.m. and 4:30 p.m. on tangent stretches of two-lane pavement, 20 ft wide overall. The weather was clear and warm and the sites selected were as free as possible from extraneous factors that might affect speed. Speeds of individual vehicles were recorded automatically as described and license numbers noted manually. About a mile beyond the speed-meter station, state police stopped the drivers for brief questioning by an investigator. The information thus gathered was put on punch cards and tabulated.

A number of driver characteristics were chosen for study. Typical of these were sex, age, marital status, place of registration, driving experience, mileage already driven on day questioned and distance still to go, price, class, and age of vehicle. When these characteristics were analyzed with respect to speed, it was possible to see many interesting and useful relationships. These may be briefly and partially summarized as follows:

1. Out-of-state cars traveled faster than Connecticut cars.
2. Vehicles approaching a city went faster than those recently leaving one.
3. Drivers on long trips traveled faster than those on short trips.
4. Women drove almost as fast as men.
5. Speed varied almost inversely with the age of the car.

When a special analysis was made of drivers in the 60 to more than 70-mile-per-hr speed range, it was discovered that women were involved in only 2% of the cases. The remaining 98%, when compared to the total sample of men drivers, showed a heavily disproportionate number of:

1. Drivers with high annual mileages (over 25,000 miles).
2. Drivers of new cars.
3. Drivers on trips of over 100 miles.
4. Drivers under 30 years of age and particularly those in the 16–19 age group.

When the number of drivers per hundred with records of speed violations, traffic violations, and traffic accidents

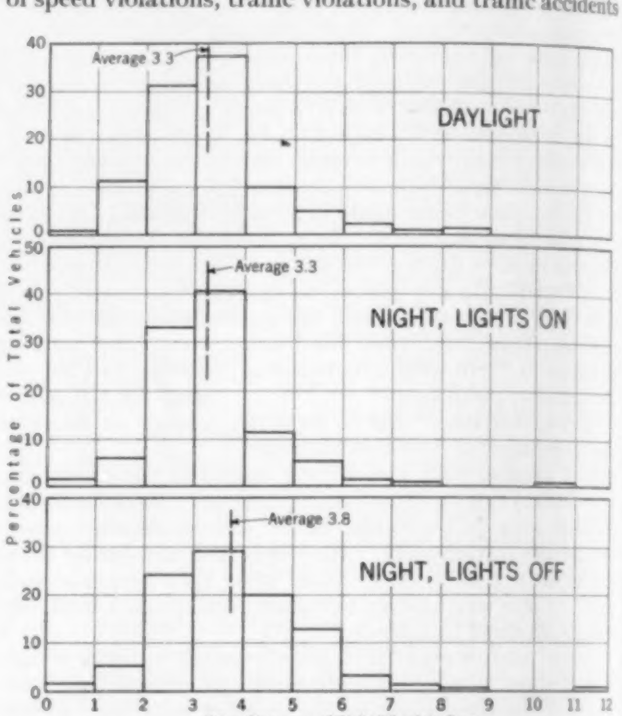


FIG. 2. FREQUENCY DISTRIBUTION OF EDGE CLEARANCES OF FREE-MOVING PASSENGER CARS ON A TANGENT

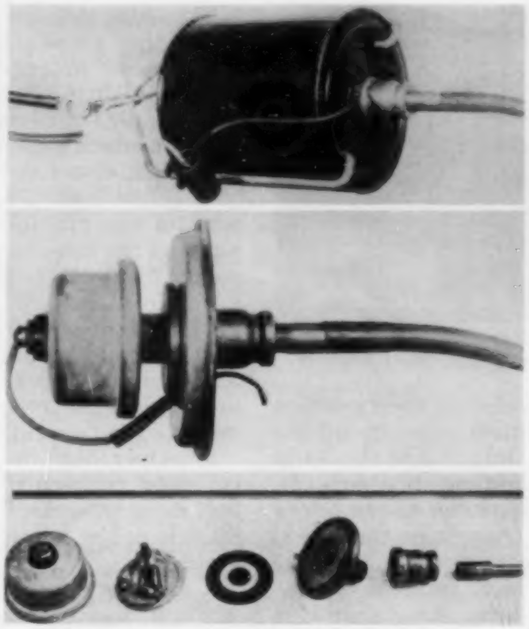
were compared in the two speed groups—35 to 45 miles per hr, and over 50 miles per hr—it was found that the higher speed group had very definitely a greater proportion.

The desirability of knowing the transverse positions of vehicles under various circumstances is obvious since on it depends the solution of many problems in highway design, safety, and economics. There have been previous attempts to determine these transverse positions. In one an observer, concealed beside the road, read the positions of wheels with respect to the edge on a large scale painted on the pavement. In another, a motion picture camera was employed to photograph, from a moving car, vehicles in the act of passing. Recently a more accurate and flexible method has been developed by the Public Roads Administration. It makes use of a segmental detector switch which is stretched across the pavement. When a wheel runs over it one of several short strips of flat spring metal is pressed against a long strip, which serves as the common side of the switch. The segments are each 1 ft long, while the common strip runs the entire length of the detector. Each segment is separately wired to one of the electro-magnetically oper-

ated pens of the recording instruments described in connection with the speed meters. Thus a mark made by one of the pens on the record paper indicates the transverse position of a wheel. In the transverse placement studies the speed meter is always used with the segmental detector because speed is one of the important factors influencing position. This is easily arranged by putting the placement detector midway of the 24-ft space between the pneumatic tube detectors which actuate the speed meters.

Because of the newness of this technique, only one application has been specifically reported. ("Effects of Highway Lighting on Driver Behavior," by W. P. Walker, *Public Roads*, December 1940.) In this instance it was desired to compare driver behavior on a road in Ohio under three conditions—day, night with road lighted, and night with road unlighted. Four criteria of behavior were measured—the time spacing between vehicles moving in the same direction, their speed, the frequency with which overtaking vehicles attempted to pass others, and transverse positioning.

Only the last of these will be discussed at this time. Figure 2, taken from the report in question, compares the frequency distribution of the clearance between the outer wheels of passenger cars and the pavement edge under the three conditions of light. The vehicles were moving freely, that is, with sufficient longitudinal intervals between them so that they exerted no influence on one another. The pavement was 20 ft wide, on a tangent, and the weather was dry. For the conditions of these observations it may be concluded that drivers use the same edge clearance at night when the roadway is lighted as in the daytime, but that at night when the roadway is unlighted they move over a half foot closer to the center of the pavement. If this is generally confirmed by additional observations, advocates of highway lighting may use it in their arguments both from the point of view of safety and as an additional justification of the cost of light installation, since the effect of lighting on placement may be similar to that of pavement widening.



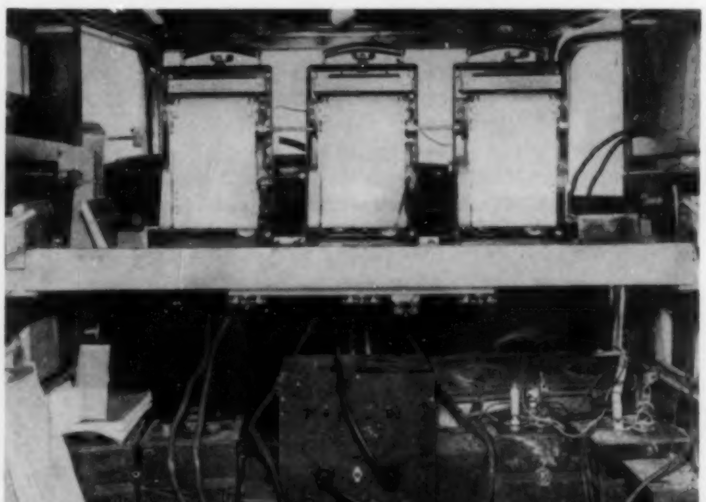
Pneumatic Detector Switch and Its Component Parts

A second typical example of use comes from the experiments now under way to determine the effect of bridge widths on both speed and transverse placement. Thus far data have been collected for about a dozen bridges. The writer has had an opportunity to examine the information for one of these—the only one that has been analyzed in detail. It is a small bridge, less than 40 ft in span, located on a highway with a pavement 20 ft wide. On the bridge the roadway between parapet walls is 25 ft wide, and the walls are 2 ft high. By locating the speed-placement equipment on the bridge itself, and also on a nearby tangent stretch far enough from the bridge to avoid its influence, it was possible to make direct comparisons of traffic behavior at the two points.

Although no general conclusions can be reached from the data applicable to this one bridge, it is of interest to note that its presence caused no significant change in speed but a pronounced shift of placement toward the center of the roadway.

The writer has also had an opportunity to examine another interesting example of use which recently came from South Carolina. The speed-placement equipment was used on curves of varying degree and also, for purposes of direct comparison, on nearby tangent sections of comparable type and width. Obviously it would be impractical to present in this paper more than a sample of the information collected in this instance.

Speed Meter in Use with Twenty Bank Counters



Speed Meter and Graphic Recorders Installed in a Truck and Concealed from Approaching Drivers

PASSING PRACTICE DETECTORS IN POSITION ON STUDY SECTION

On the tangent section the cars shifted their position progressively away from the pavement edge toward the center as their speed increased. Only 2% of the 3,043 cars observed were traveling in the highest speed bracket, 65–70 miles per hr, and they shifted so far to the left of the normal position as to actually trespass on the opposing traffic lane. Had another car been passing in the same position, a collision would have resulted. However, other data, not presented here, show that cars passing one another at this same location and at these high speeds had a clearance between cars of nearly 3 ft.

Another study showed the speeds and positions of free-moving cars on a curved section, a 4° curve with a superelevation of 0.06 ft per ft. It was immediately seen that cars on the inside lane followed the lane center line closely at all speeds, while those on the outer lane did not. Even in the lowest speed brackets there was a tendency for drivers in the outer lane to "cut corners" and as the speed increased this tendency became steadily more pronounced; at higher speeds, 50 miles per hr and over, cars in the outer lane had shifted so far to the inside of the curve that they would have been in contact with cars occupying normal positions in the inner lane were such cars present.

The examples referred to are but the vanguard of a much larger number of applications. Already the results of other measurements made in several states are being analyzed and when these are assembled and correlated many uncertainties should be cleared up.

Intimate information about passing practices is obtained by making use of pneumatic-tube detectors laid 50 ft apart over a half-mile stretch of highway. Each tube is plugged at its center so that each half of it serves as a detector for one lane. The contacts of wheels with detectors are recorded at three synchronized stations, each of which is provided with two recording instruments previously described. These involve 120 recording pens in all. The paper charts, on which the pens record, move through all six of the machines at a uniform synchronized rate so that measurements along them can be reduced to time. The presence of any vehicle moving outside its normal traffic lane is easily distinguishable from those moving in their proper lanes. This enables a continuous automatic record of the instantaneous positions of all vehicles moving in the half-mile test section.

It is the special advantage of these investigations that they will permit the study of potential as well as actual accidents, under conditions that admit of no dispute, and used in this way they are certain to prove extremely valuable in the campaign for greater safety. To a limited degree some of this information is already coming to light as a result of the work done thus far; but much further analysis of the mass of recordings must be made before specific conclusions can be drawn.

To illustrate, the following typical indications are cited; they are selected from the first report on the passing studies ("Progress in Study of Motor-Vehicle Passing Practices," by O. K. Normann, *Public Roads*, Feb. 1940). They apply, of course, only to the four study sections used, on which a total of 1,635 maneuvers were observed, and should therefore not be used as general conclusions.

1. Over half (57.3%) of all passings accomplished were of the multiple type; about half of all multiple passings are those in which one vehicle either passes or is passed by two vehicles.

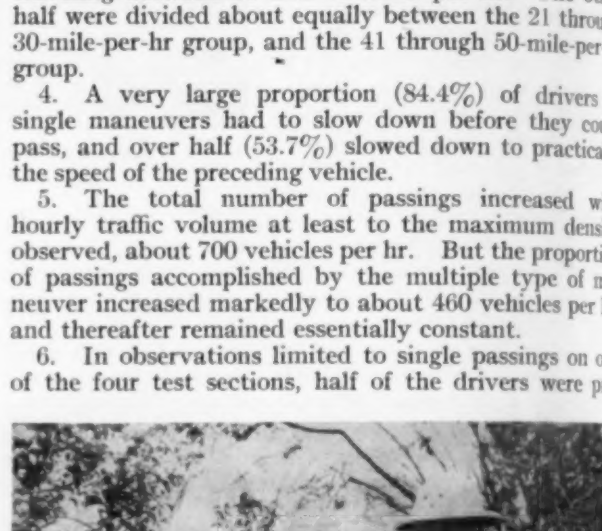
2. Over half (51.4%) of those who passed other vehicles desired to travel less than 11 miles per hr faster than the vehicles passed; 21.2% of them desired speeds less than 6 miles per hr faster. Drivers desiring to travel at a slightly higher speed than that of the vehicles ahead preferred to pass rather than reduce speed slightly.

3. Over half (55.0%) of the vehicles passed were traveling between 31 and 40 miles per hr. The other half were divided about equally between the 21 through 30-mile-per-hr group, and the 41 through 50-mile-per-hr group.

4. A very large proportion (84.4%) of drivers in single maneuvers had to slow down before they could pass, and over half (53.7%) slowed down to practically the speed of the preceding vehicle.

5. The total number of passings increased with hourly traffic volume at least to the maximum density observed, about 700 vehicles per hr. But the proportion of passings accomplished by the multiple type of maneuver increased markedly to about 460 vehicles per hr, and thereafter remained essentially constant.

6. In observations limited to single passings on one of the four test sections, half of the drivers were prevented from making full use of the maximum sight distance the road provided (1,900 ft) because of the presence of oncoming vehicles, and had to postpone the maneuver.



ONE OF THREE SYNCHRONIZED RECORDING STATIONS USED IN PASSING PRACTICE STUDIES

7. A surprisingly large number of drivers did not attempt to pass until after reaching a point where the sight distance was considerably less than it was where they could have started to pass.

These, then, are representative of the kinds of facts that are being uncovered in rich abundance by these new techniques. And it should be carefully noted that they make overall measurements both of the vehicle and of the driver, taking into account the effect of physical characteristics of the road and the surrounding stimuli.

Engineering Aspects of Safety Work in Railroad Maintenance

By George M. O'Rourke, M. Am. Soc. C.E.

Assistant Engineer Maintenance of Way, Illinois Central System, Chicago, Ill.

In the "all out" defense effort, safety takes on new aspects of national importance. Railway maintenance of way and structures must be carried on with maximum efficiency and minimum loss of man power, not only from the humanitarian point of view but also because each man must produce as an integral part of one great movement. Thus an accident involving lost time in railway work is so much loss to the great defense effort and as such must be eliminated. The precautions and safety methods described have implications that carry far beyond a limited field. In this paper Mr. O'Rourke emphasizes again the necessity for continued vigilance and education in keeping down the accident toll.

Maintenance of way and structures on our railroads is carried on through the economical use of men, machines, and materials. The most valuable and the most expensive of these elements is men. Every time a new worker is employed to replace one disabled, money is spent that could have been saved. The average cost of training, educating, and equipping a worker for his job is $7,600. This task is first and last an engineering undertaking. Conservation of human resources is a challenge to engineers and technicians.

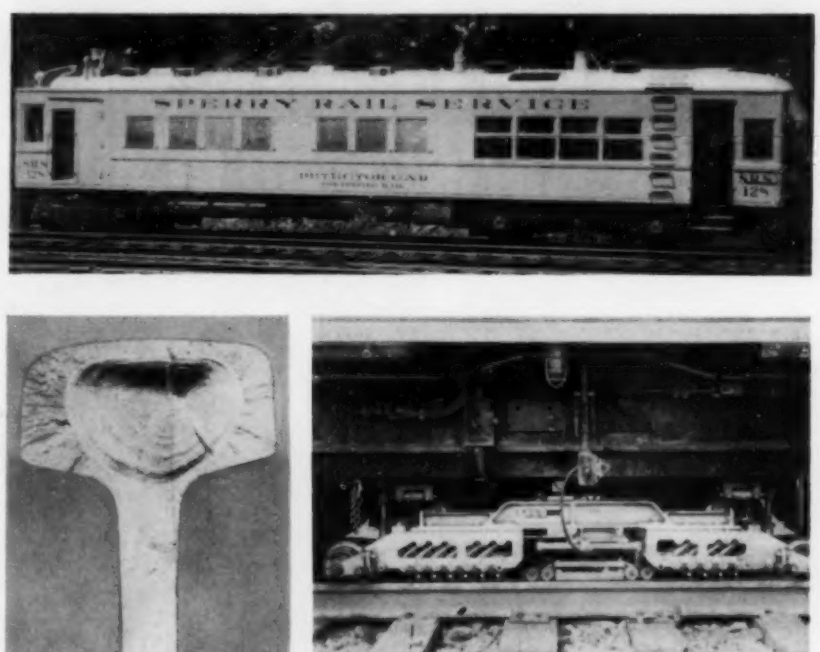
There are 236,800 miles of railroad and 420,100 miles of track in the United States. The fact that the maintenance forces are scattered over such distances makes the problem of supervision and education extremely difficult. On the basis of number of persons employed, the leading occupational group in railroad service is composed of section-men, who repair and maintain those thousands of miles of track. How to plan and organize such work for increased efficiency with safety is the subject of this article.

Heavy axle loads moving at high speed require safe and durable rail. Safety and wear resistance have been recognized as the paramount objective, and close attention to metallurgical control has resulted in a steel superior to that produced even a few years ago. The American Railway Engineering Association, the steel companies, and the University of Illinois operate a laboratory where experiments are conducted on ways of making steel rails tougher and stronger, while all over the country electric "detector" cars are "feeling" with magnetic fingers for hidden defects in track rails. The first of these detector cars was built in 1927 by Dr. Elmer A. Sperry, an eminent engineer, in cooperation with the American Railway Engineering Association. In the last decade more than 600,000 miles of track have been tested by the Sperry fleet of cars, with the result that nearly 500 miles of rails containing fissures have been removed and about 600 miles of otherwise defective rail has been located. Engineers have determined that transverse fissure failures result from internal shatter cracks. These shatter cracks are being eliminated by a process for the controlled cooling of new rails originated in 1931.

Although the weight of rail has been increased from a maximum of 50 and 60 lb per yd up to 112, 131, and even 152 lb, this has not solved the whole problem. It has been definitely proved that unknown conditions related to locomotive load distribution are damaging and costly to both locomotive and track when locomotives run at high speeds. Track has been blamed for the rough riding of locomotives and for derailments when the real cause was the unbalanced condition of the locomotive. Calculated weights cannot be relied upon, so engineers have designed and built locomotive wheel-load scales that may be trusted to provide scale weights for adjusting the load distribution. The result is a reduction in bent and broken rails.

The Association of American Railroads is conducting research projects on the cause and detection of hidden defects in rails, the effects of high-speed trains on tracks, the strength of welded joints for rails, and the heat treatment of rail ends to prevent wear. It has a safety section, organized in 1921, to promote safety for employees, for passengers, and at grade crossings. Its work is educational, preventive, and statistical. Its results in safe transportation are self-evident.

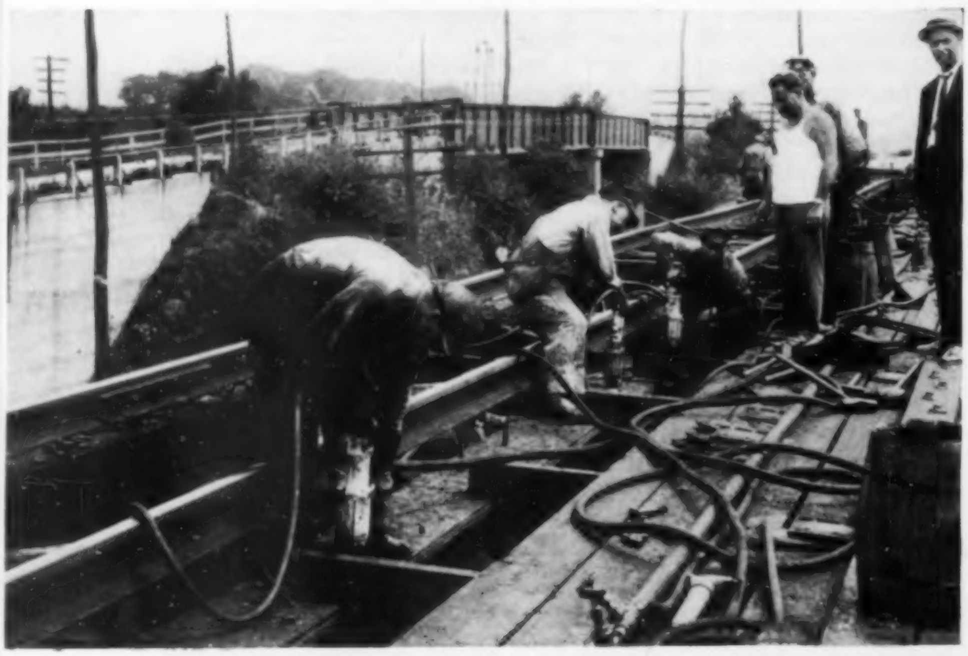
Operating and maintenance conditions today emphasize the need for that engineering specialist, the signal engineer, who continues with unabated energy to direct the safe movement of trains at high speeds. This specialist devotes his life to a study of the effectiveness of protective devices. At the end of 1939 we had in the



Sperry Detector Car (Top View) Detects Rail Defects Such as Transverse Fissure (Lower Left) by Means of Contact Device (Lower Right)

At Work with a Compressed-Air Screw Spike Driver

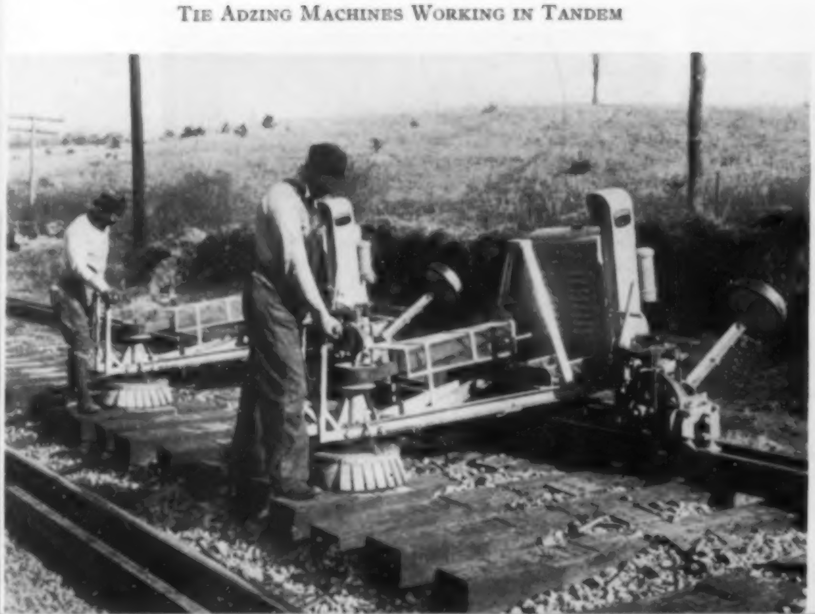
Weed Burner Melting Snow and Ice to Facilitate Drainage



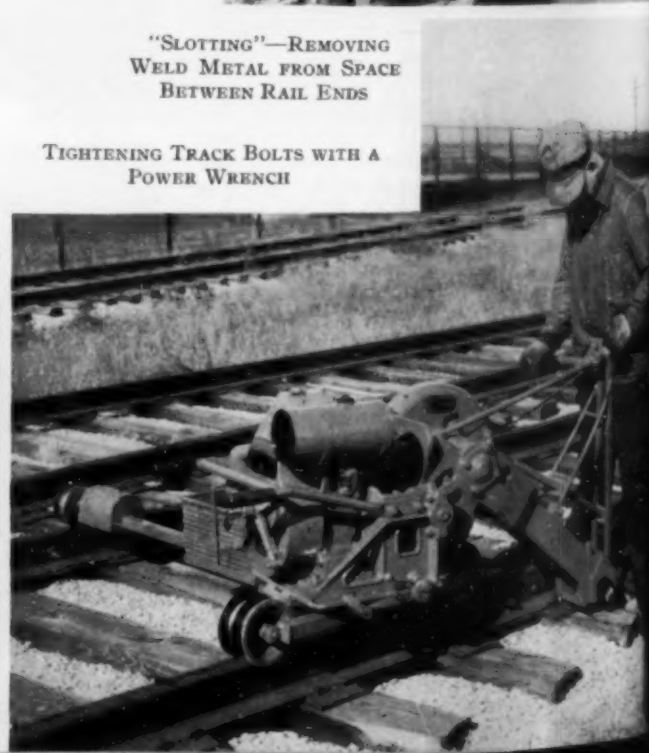
Using Compressed-Air Tools on Bridge Construction

Mechanized Gang Using Compressed Air Spike Drivers

"Slotting"—Removing Weld Metal from Space Between Rail Ends



Tie Adzing Machines Working in Tandem



Tightening Track Bolts with a Power Wrench

United States 23,000 grade crossings protected by signals; 32,500 guarded by signals, gates, and watchmen; and only 190,000 protected by signs alone. The importance of the work of the signal engineer cannot be overemphasized. Signals and signal track appliances are inspected and tested regularly, as directed by the Interstate Commerce Commission through the Signal Inspection Act.

In the field of technical progress, scientific illumination has effected a sharp reduction in accidents. Many lost-time personal injuries are caused by poor or improper lighting. Thus the engineer in the field of electricity aids materially in safely maintaining structures and way. The inspection of materials has been greatly advanced by the use of steel dust on magnetized steel and X-ray photostatic studies and by electrical gages for determining stresses in track and structures at various speeds and loads. At several places special electrical measuring devices have been installed under sections of track to register performance under actual traffic. These modern field testing methods of the railroads and their practical research laboratories have made it necessary for manufacturers to keep pace and they have cooperated.

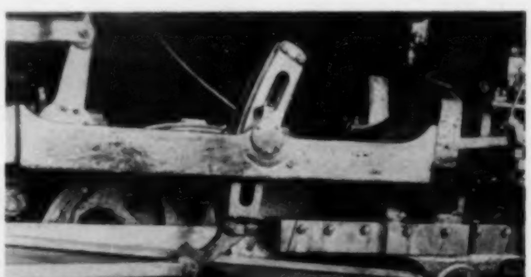
Mechanization of maintenance operations is one of the chief contributions of the engineer to economical methods. Expenditures for maintenance of way and structures during the years 1920–1929 amounted to more than eight billion dollars. In the last ten years these expenditures have been cut very nearly in half. For every $600 invested in machinery it is possible to dispense with the services of one man for one year. When it is considered that approximately 47% of the total railroad revenue is allotted to labor, the economy of mechanization is obvious. Inherently an industry that must be conservative in its acceptance of the new, the railroads were at first slow to take advantage of the economies available from mechanization. However, they found that they could not afford to be so conservative, and during the past decade have made extraordinary progress in mass production.

It is an impressive sight to see a gang of 100 men report for work relaying rail and drop into place one by one. They are brought to the job on motor cars and trailers equipped with safety seats and couplers. They are required to wear safety shoes with steel caps to protect the toes and are provided with goggles to avoid eye injuries. Nuts are removed from track bolts with power wrenches; track spikes are removed with a mechanical spike puller; ties are adzed to a level plane with a machine and the adzed surface is swabbed with creosote oil by machine. New rails are lifted into place with a power crane and the joints are bolted together again with a power wrench. New spikes are put in place with compressed-air drivers, and the signal bonding is done with power drills. To perform the same work by hand would require 250 men and involve increased hazards to personnel.

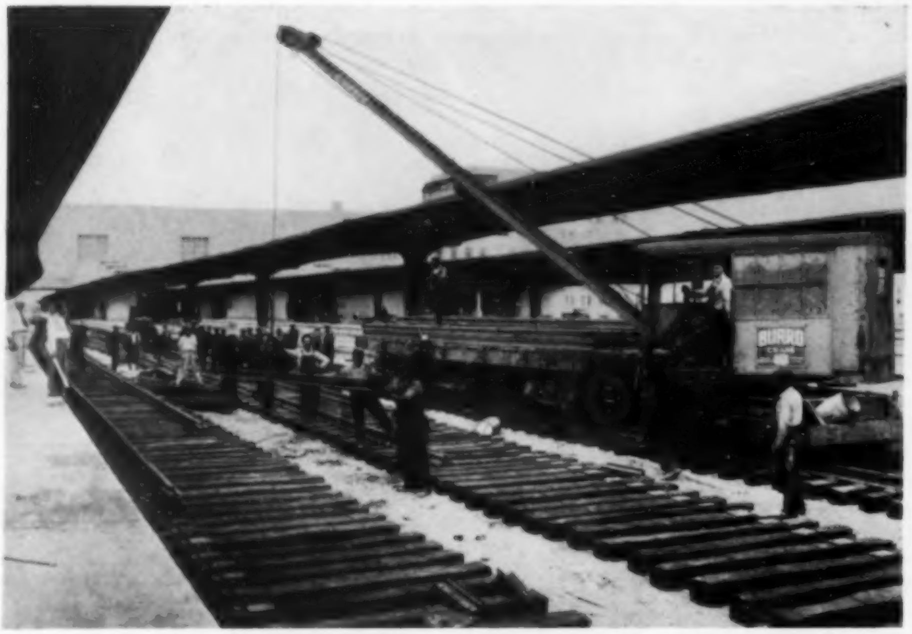
Section gangs have been mechanized by the addition of motor cars and ballast tamping tools; bridge and building gangs have been provided with power saws, augers, planes, and other tools. Yet railroad engineers feel that thus far they have been but pioneering in the economic possibilities of mechanization and safety education. Extensive mechanization presents a safety problem as it requires, for some operations, considerable thought on the part of the engineer, work by the supervisory organization, and the complete cooperation of the workmen, who must strictly obey the safety rules besides using common sense.

Order, discipline, and responsibility are functions of engineering and these are particularly needed in safety work. The engineer's relation to labor is a continuing one. Because of the human factor, education is the greatest single means of accident prevention. A sound safety promotion program, planned and administered by the engineer with the intent of achieving a high safety record, should provide a continuous educational program for every individual employee. The engineer must encourage proper fundamental habits and skills in subordinates and laborers, and must develop in them the ability to recognize

"Men at Work"—Removing Rust and Scale with Compressed Air Cleaning Hammers



Locomotive Driving Wheel Being Weighed on Wheel-Load Scale to Ascertain Whether Counterbalance Is Correct



Mechanized Handling of Rails Prevents Accidents and Facilitates Work
Self-Propelled Crane Moves Car Along as Work Progresses

and cope with the safety problems they encounter. If they have developed the habits and skills necessary for the efficient performance of their tasks, they will be more likely to perform these tasks in safety. To accomplish all this requires the organization of the supervisory staff and others for the primary purpose of promoting safety.

Accident costs indicate the need for safety activities (see Accident Bulletin No. 108, Interstate Commerce Commission, Bureau of Statistics, for the calendar year 1939). Table No. 55 of this bulletin gives casualties by individual employee reporting divisions and by maintenance groups in relation to man-hours worked. The total casualties in train, train service, and non-train accidents on railways of all classes were 114 killed and 4,025 injured. The highest casualties were among section track laborers, of whom 37 were killed and 2,054 injured.

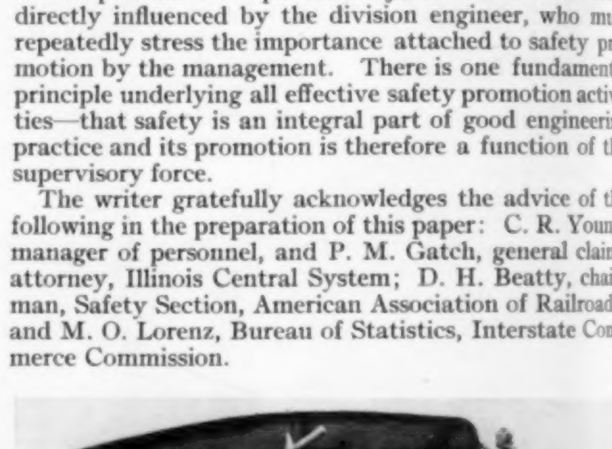
Tables Nos. 61, 62, 63, 65, and 66 classify train accidents so as to show those caused by defects in, or failure of, equipment, and those due to improper maintenance of way and structures. The amount of damage to railway property through accidents of this kind is also shown. Defects in track, bridges, switches, and signals, or other defects in the roadway caused 694 train accidents and $1,246,606 damage to railway property, besides 7 deaths and 163 injuries. The greatest single cause of accidents was broken rails, which resulted in 229 derailments. Table No. 99 shows, by railways, casualties in relation to man-hours for maintenance groups and others. Train and train service accidents caused the death of 48 maintenance-of-way and structures employees and injured 180. Non-train accidents killed 54 and injured 3,262 men engaged in that work.

The bulletin observes that "notable progress has been achieved by railway managements in making work less hazardous for their employees." It refers to safety contests and other developments which have "led reporting officers to exercise great care in distinguishing the injuries which are reportable to the Interstate Commerce Commission from those which are not reportable.

The value of these and other accident statistics is dependent upon the use made of them. Safety meetings are indispensable if utilized as an active means of acquainting the working force with these statistics. When held at regular intervals, such meetings afford an excellent opportunity for engineers to keep in close touch with the accident situation and to emphasize the safety policies of the company. To prove effective they must be planned carefully in advance and be educational in purpose. Otherwise interest is soon lost and little value is obtained.

On large railroads it is customary to set up a safety committee for each of the subdepartments on a division. The committee in the maintenance-of-way and structures department is presided over by the division engineer and consists of the following personnel: bridge and building supervisor, signal supervisor, electrified zone supervisor, track supervisors, water service supervisor, and assistant engineer. The supervisors in turn hold meetings to which the foremen come. The most successful of such meetings are those conducted for the express purpose of placing responsibility on individual employees for the elimination of unsafe practices. The attitude of the supervisors is generally considered as the determining factor in the success or failure of work for the prevention of personal injuries. This attitude is directly influenced by the division engineer, who must repeatedly stress the importance attached to safety promotion by the management. There is one fundamental principle underlying all effective safety promotion activities—that safety is an integral part of good engineering practice and its promotion is therefore a function of the supervisory force.

The writer gratefully acknowledges the advice of the following in the preparation of this paper: C. R. Young, manager of personnel, and P. M. Gatch, general claims attorney, Illinois Central System; D. H. Beatty, chairman, Safety Section, American Association of Railroads; and M. O. Lorenz, Bureau of Statistics, Interstate Commerce Commission.



Ballast-Stripping Machine Takes Over Tedious Pick-and-Shovel Job

Railroad Relocation and Construction Around Shasta Dam—Part II

By J. A. Given, M. Am. Soc. C.E.
Location Division Engineer, Southern Pacific Company, Redding, Calif.

Railroad construction across Shasta County, like the location work described in Part I, presented unique problems because of the mountainous terrain. This country is so rugged that the yards for steel storage had to be specially constructed, while tunnel portals, drainage facilities, cuts, fills, and crossings, were all of heavy mountain types. Part I, in the August issue, dealt with reconnaissance, preliminary, and final surveys. In this paper, Mr. Given describes the actual construction.

When the Bureau of Reclamation had completed its surveys for the Shasta Dam project, preliminary conferences were held between its engineers and those of the railroad, and tentative specifications and plans were prepared by the Bureau and submitted to the railroad. When the plans were in mutually satisfactory shape, they were published in book form and issued to all contractors who desired to bid on the work. The entire job was split up into 16 contracts so as to permit contractors specializing in tunnel, bridge, concrete, and grading work to bid to advantage. The fact that the area was accessible from nearby highways and county roads made rapid construction possible, as the work could be attacked at numerous places. As a result the bids were no doubt much less than they would have been in pioneer country.

The Bureau had available many men with experience in the construction of tunnels, bridges, and structures of various kinds as well as experts in the construction of earth-fill dams and canal embankments. All the construction work was directed and supervised by the Bureau, whose engineers worked in collaboration with those of the railroad. The excellence of the finished product is a credit to their supervision.

The Bureau maintained a soils laboratory and kept compaction experts in the field. Before cuts were opened, test pits were dug and samples sent to the laboratory to determine the character of the material and the proper moisture content for reasonable compaction. During the progress of the work frequent samples were taken from the fills and tested in order to determine whether or not the proper degree of compaction was being secured.

Contractor's equipment consisted largely of Diesel tractors, mostly 90 hp, equipped with bulldozers (and in a few special cases with cow dozers), carryalls up to 32 cu yd in capacity, rooters, and patrol graders. Tank trucks or water lines were used to supply the necessary moisture, where needed, and sheepsfoot tampers were employed where required in narrow draws and in backfilling structures where ordinary compaction equipment could not be utilized. Backfills at culverts and structures were compacted with pneumatic tampers where they contacted the concrete, and the sheepsfoot tampers then worked as close to the structure as possible. Less than 5% of the yardage had to be so treated.

Compaction for the most part was secured by spreading the material in thin, horizontal layers and by carefully routing the equipment over the fills. In general, material from two or more cuts was mixed in proper proportions to make the fills. The slopes of cuts were trimmed by patrol graders with their blades set to conform to whatever slope was designated, the patrols working down through the cuts as they were being excavated. Comparatively little powder was used, as the rooters could loosen almost anything but solid rock. All the grading was divided into 12 schedules so that the material in each schedule would be of approximately the same geological formation, with the result that most of the excavation bids were unclassified.

Slopes of cuts varied between $1/2$ on 1 and $1\,1/2$ on 1, depending on the character of the material. In general the cuts were benched at intervals of 60 ft vertically, the benches being 16 ft wide sloping away from the track, on grades parallel to the track to carry the drainage. The maximum height of cut was 105 ft, and the maximum fill 100 ft at the center line, although in sidehill country one cut ran to a height of 228 ft, and one fill to a depth of 200 ft. Wherever waste material from cuts was available, it was placed in such a position as to provide a fillet to round out the adjacent fill at its junction with the natural ground so that drainage from the cut would be led around on solid ground and discharged in such a way as not to damage the fill. At the downgrade ends of cuts, perforated drain pipes were installed in the subgrade to keep water from seeping on to the fills.

Because of the type of equipment used by the contractors, practically all the cuts were opened at the top and excavated progressively to grade. Where deep cuts were to be excavated, the survey parties set hubs in such posi-

Twin Drifts Meet Underground to Form Single Tunnel Arch
Steel Ribs Are Then Constructed from Inside Toward Portals

SALT CREEK BRIDGE PIERS LOOKING TOWARD TUNNEL NO. 9
Design of Piers Provides for Possible Future Double Tracking Without Excessive Lake Drawdown

tion that a transit set over them could be sighted down the slope. Frequent guide stakes were provided as the excavation proceeded.

Where fills extended into the reservoir area, that part of the fill from the toe to a point 5 ft above high water was built of sluiced rock. After the underlying ground had been carefully benched and prepared, large rock 3 to 5 ft square was brought in and placed in a horizontal layer. Small rock was then sluiced into the voids by means of powerful streams of water. When the voids in one layer were filled, another 3 to 5-ft layer of large rock was brought in and similarly treated. Thus free-draining fill was built which will not slide when the reservoir is drawn down.

In general, grading contractors worked two shifts and sometimes three, using portable electric lighting outfits for illumination. Approximately 5,800,000 cu yd of earth was handled, exclusive of 490,000 cu yd of tunnel excavation.

The concrete mix was carefully controlled by the field inspectors and the concrete laboratory. Water in local streams and wells was analyzed, and if it was not suitable, the contractor was required to bring in water from an approved source. Concrete aggregates consisted of sand and gravel obtained from local processing plants near Redding. The concrete was placed as dry as practicable, and internal vibrators were used in the forms to assure a uniform product free of rock pockets.

Culverts varied in size from 16-ft reinforced concrete arches to 18-in. pipes. Both reinforced concrete pipe and corrugated metal pipe, the latter bituminous coated with paved inverts, were used. Reinforced concrete boxes were placed where they best fitted the channel condition.

Nearly all the side streams are subject to storms of cloudburst intensity, and carry at times considerable quantities of sand, gravel, and even boulders. Under such conditions the proper location of a culvert, especially the inlet and outlet, is of great importance. In numerous places in the reservoir area the outlets of culverts were in natural streambeds. Such outlets had to be carefully placed so that they would not be submerged at high water, an obviously dangerous condition in streams carrying heavy debris. Fortunately in all such places the natural slope of the country was fairly steep, and it was possible to place the culverts on much lighter grades so that they would discharge above reservoir level. This is possible because the velocity through concrete structures on light grades is equal to the velocity in rough stream channels on heavy grades.

At all culverts 5 by 5 ft or larger, the right-of-way fences were brought in to the ends of the culverts in order to avoid placing fence posts in stream channels, and also to permit sheep and cattle to pass back and forth, thus avoiding many private crossings at grade.

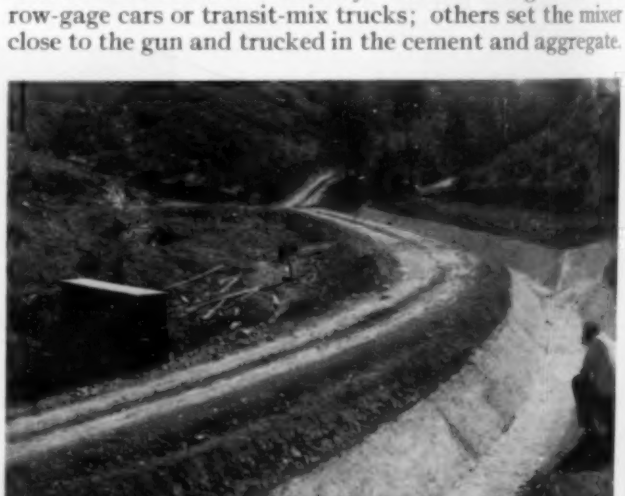
In four cases streams were carried over tunnels, near the portals, in concrete-lined channels. At three locations the line of the survey crossed small streams at right angles where the profile grade was several feet below the stream bed. Fortunately all were in sidehill country where it was possible to build a drop inlet culvert with a moderate length of artificial channel downstream.

There are 12 tunnels with a total length of 19,070 ft; the longest tunnel is 2,719 ft, the shortest 745 ft. All the tunnels are concrete lined throughout, with concrete curbs and gutters. Tunnels less than 1,700 ft in length have a height of 22 ft 6 in. above final top of rail; longer tunnels have a height of 24 ft.

Two of the tunnels, south of the Pit River, were driven through solid diorite; these were driven full face and required no support except near the ends. The other ten tunnels were driven through formations varying from diabase to shales, and in one case through an ancient river bed. They were all excavated by taking out first a top heading from the crown to a point 3 ft below the springing line, and later a bottom heading down to 12 in. below profile grade, this latter being backfilled with selected material. Drilling was done from jumbos, and mucking was done with electrically operated Conway muckers loading into narrow-gage dump cars hauled by storage-battery locomotives.

Wherever the ground needed support, 8-in. H-beam steel ribs were used, and precast concrete blocks were placed back of the ribs to prevent the timber lagging from touching the ribs. These steel ribs were afterward concreted in and formed part of the reinforcing. At all points where there was any evidence of water, metal pans and drain pipes leading to weep holes were provided before concreting.

Lining was placed with pneumatic guns blowing the premixed concrete into steel forms. Most of the pours covered a 50-ft length of tunnel, although some were 60 ft and a few 70 ft. Some contractors mixed the concrete outside the tunnels and conveyed it into the gun in narrow-gage cars or transit-mix trucks; others set the mixer close to the gun and trucked in the cement and aggregate.



CONCRETE-LINED CHANNELS CARRY TWO SMALL STREAMS OVER NORTH END OF TUNNEL NO. 7

There are eight steel bridges on the relocated railroad. The First Crossing of the Sacramento River is 4,350 ft long with a maximum height of 101 ft. It consists of three deck trusses each 168 ft long over the river channel. The remainder is of viaduct construction using steel towers and deck plate girders. A portion of the viaduct towers were erected by a crawler crane on the ground, the steel being hauled by trucks. The remainder of the bridge was erected by a locomotive crane working on temporary track on the deck. Steel piling was driven for the falsework for the trusses.

The Pit River Bridge carries two railroad tracks on the lower deck and four highway lanes on the upper deck. This structure is 2,758 ft long on the railroad deck, and 3,588 ft long on the highway deck. Over the present Pit River (which will become an arm of the reservoir) the height above low water to the railroad deck is 436 ft, and to the highway deck, 500 ft. Lengths of trusses on the railroad deck, from south to north, are consecutively as follows: 141, 282, 498, 630, 498, 282, 282, and 141 ft. The piers are of reinforced concrete, and the highest is 360 ft.

Structural steel was delivered by work trains from Redding to a material yard south of the bridge, and from Delta to a similar yard north of the bridge. Steel was unloaded and sorted in the material yards and taken to the bridge on freight-car trucks, specially rigged for the purpose. A heavy traveler on the upper deck handled the truss members and a lighter traveler followed behind handling the highway floor members. Erection proceeded progressively from the south end of the bridge to the center of the 630 ft (cantilever) span. The equipment was then transferred to the north side of the bridge and erection will be continued to a connection at the center of the main span. Falsework consisted of steel bents—suitable members of trusses not yet erected—resting on concrete foundations.

O'Brien Creek Bridge consists of two 200-ft deck trusses, together with six deck plate girders. Its total length is 1,028 ft and its maximum height 181 ft. All structural steel was delivered at Pollock on the operated line, and hauled by trucks some $3^1/_2$ miles to the bridge site, where it was erected by a guy derrick working on the deck. Falsework for the trusses consisted of parts of the floor system.

Salt Creek Bridge consists of four 175-ft deck trusses with seven deck plate girders. The total length is 1,391 ft and the maximum height 167 ft. This bridge was erected with a locomotive crane working on temporary track on the bridge deck. Steel was delivered at the north end of the bridge by work trains. Timber falsework was used under the trusses.

The Second Crossing of the Sacramento River consists of three 200-ft deck trusses, together with four deck plate girders. The total length is 1,040 ft, and the maximum height 206 ft. This bridge not only spans the Sacramento River, but also the operated line. Temporary tracks were built alongside the operated line and structural steel delivered on cars there. A guy derrick was assembled on the ground, and using parts of one of the truss spans, built a steel tower one panel off center with the truss. The derrick was jumped up as the erection of the tower progressed until it was finally at the elevation of the lower chord. Then this chord from the tower to the nearest pier was set and anchored to the pier. When this portion of the truss was completed, the derrick was jumped to the top chord. The remainder of the truss was erected by cantilevering out from the falsework tower. The two remaining trusses were erected without falsework, as they were designed for erection stresses resulting from cantilevering out their full length. A second guy derrick was used to lift steel from below and place it on construction cars for delivery to the erecting derrick.

Doney Creek Bridge consists of three continuous deck trusses with a total length of 581 ft and a maximum height of 160 ft. Structural steel was delivered at Pollock and hauled by trucks about $1^1/_2$ miles. A guy derrick

THIRD SACRAMENTO RIVER SPAN CROSSES PRESENT OPERATED LINE

worked progressively from the north to the south end of the bridge. Falsework for the first truss consisted of the floor system of another truss. After the first truss was swung, the others were erected by cantilevering out from it.

The Third Crossing of the Sacramento River consists of one 200-ft deck truss together with six deck plate girders. It has a total length of 758 ft and a maximum height of 100 ft. A locomotive crane on temporary track on the deck handled this structure. Steel was delivered on the relocated line near Delta Junction, about a mile away, unloaded, sorted, and moved to the job on freight-car trucks by rail. Falsework for the truss consisted of steel piling.

The Fourth Crossing of the Sacramento River, which has a total length of 308 ft and a maximum height of 67 ft, consists of three deck plate girders. A locomotive crane, on temporary track on the deck, set the three girders without the use of falsework. Steel was delivered on the relocated line near Delta Junction a quarter of a mile from the bridge, unloaded, sorted, and moved to the bridge with the locomotive crane.

At the First Crossing of the Sacramento River the trusses are on concrete piers, the viaduct towers are on concrete pedestals, and there are concrete abutments at both ends. All the other bridges are in the reservoir area and are built with concrete abutments and piers. Piers with footings that will be submerged in the reservoir are built for a future second track, the second-track portion being brought up to within at least 40 ft of high-water elevation. It is assumed that the reservoir will be drawn down in the summer so that concrete for the second track can be poured.

On the entire length of the relocated railroad there is only one permanent public road crossing at grade, a county road that will be protected by flashing-light signals. Two other county roads crossing at grade will be in use until the reservoir starts to fill and will then be closed. Of grade separations there are 14 permanent

STIFF-LEG DERRICKS ERECT STEEL BRIDGE FOR SECOND SACRAMENTO RIVER CROSSING

Design of Piers Provides for Possible Future Double Tracking

ones and 3 temporary ones. Two of the latter will be removed and replaced with fills, and the third (a timber structure) will be removed when the present highway is abandoned.

Main track was laid with creosoted Oregon fir ties, double-shoulder tie plates, and curved-rail gage plates on curves and bridges. On the main track 131-lb rail is used on curves and tangents less than 1,000 ft long, and 112-lb rail on longer tangents. Passing tracks are laid with second-hand 110-lb rail, and other auxiliary tracks with second-hand 90-lb rail. Ballast is slag from the Kennet and Keswick pits, where copper smelters formerly operated and left large piles of it as a by-product. Turnouts to passing tracks are No. 14, and others are No. 10.

No work trains were used for track laying; all the material for the main tracks was hauled out from the material yard by trucks and deposited in place on the grade. Both rails and ties were loaded and unloaded with truck cranes. Rails were handled individually and ties in bundles of 12 with rope slings. Rails were handled first and were both placed on the same side of the grade. The ties came later and were laid across the rails, two sling loads per rail length. Angle bars and joint tie plates were placed at the rail ends, intermediate tie plates in piles. Bolts and spikes were distributed at equidistant intervals. Where curved-rail gage plates were required, they were applied in the material yard or on the grade. When all the material had been distributed there was still room for trucks to drive on the grade.

When everything was ready for track laying, say between two bridges under construction, trucks hauled in a track-laying burro crane and air compressor. Part of the track gang distributed ties on the grade and applied tie plates; the others cleaned and lubricated the rail ends and angle bars. The burro crane laid the rail on the tie plates, and the air compressor furnished air for the pneumatic wrench, used to tighten the track bolts, and for the pneumatic hammers, used to drive the track spikes.

As soon as a bridge was completed, work trains hauled ballast over the track previously laid to the next bridge. Siding material was unloaded direct from the cars to save the cost of handling through material yards.

In ballasting, the first two lifts were made with a power jack and the ballast shovel tamped. When as many work trains as practicable had passed over the track, the final lift (1 to $1^1/_2$ in.) was made and air tamped, after which the ballast was dressed to the standard section.

As previously stated, no work trains were used in track laying, although they were used to haul in all the ballast. The structural steel for the Salt Creek and Pit River bridges was also delivered by work trains operating over the relocated line from the junctions at Redding and Delta. By closely coordinating the ballast requirements of the track gangs with similar requirements of the bridge contractors, work trains performed a dual service.

There are six sidings, numbered consecutively, each of which holds a 112-car train. One additional siding (No. $3^1/_2$), part of which is on the Pit River Bridge, holds an 86-car train. Small station buildings are to be put up at sidings Nos. 2 and 6. Section buildings will be provided at sidings Nos. 2, 4, and 6, and a signal maintainer's house at siding No. 4. Water for domestic use and fire protection will be supplied at these three sidings.

Sidings are not ideally spaced for the best movement of trains. By double tracking certain bridges and tunnels, such spacing could have been secured, but at an exorbitant cost. It was much more economical to install a Centralized Traffic Control System to overcome the operating disadvantages of the spacing of sidings; this system will be handled by the dispatcher at Dunsmuir, 25 miles north of Delta. Between Redding and Delta all trains will be handled by signal indication, the dispatcher lining up switches, which are electrically operated, in advance so that trains may enter or leave passing tracks without stopping.

A fuel station with facilities for unloading, storing, heating, and delivering fuel oil to locomotives will be built at siding No. 1 to take the place of a similar plant on the operated line at Morley. Locomotive water stations will be provided at sidings Nos. 1 and 6. Extensive search was made for springs; some were found but produced an insufficient quantity. Since geological studies indicated that wells were out of the question, it will be necessary at both stations to establish pumping plants on the Sacramento River.

Preparation of the plans and specifications and general supervision of the work are under the direction of the chief engineer of the U.S. Bureau of Reclamation; they were commenced by the late R. F. Walter and are now under S. O. Harper, both Members Am. Soc. C.E. The Bureau's engineers in the field are Ralph Lowry, construction engineer, and the late R. M. Snell, his assistant in charge of railroad construction, both Members Am. Soc. C.E. C. M. Jackson, chief inspector, is assisted by a number of able field inspectors. The Southern Pacific Company is represented by W. H. Kirkbride, M. Am. Soc. C.E., chief engineer; E. E. Mayo, assistant chief engineer; and G. W. Rear, M. Am. Soc. C.E., bridge engineer, assisted by the staff at San Francisco and a small engineering force at Redding, with J. A. Given, M. Am. Soc. C.E., directly in charge.

Economic Possibilities of Denison Dam

From an Address Before the Texas Section

By G. E. Textor

Major, Corps of Engineers, U.S. Army; District Engineer, Denison, Tex.

In addition to the engineering and geological features of a large dam there are other important considerations seldom comprehended by one man. To view Denison Dam, or any comparable project, in its entirety, these considerations must be taken into account. In this paper, presented before the Texas Section at its fall meeting in Dallas and printed in the Section's publication, "The Texas Engineer" for June 1941, Major Textor outlines the economic factors that make the construction of Denison Dam possible.

In accordance with the regular procedure of the U.S. Engineer Department, one of the earliest steps to be taken in the examination of a proposed project is to survey and evaluate all the benefits which may reasonably be expected to accrue. This information is needed to determine whether the proposed construction is financially sound; that is, whether the total cost is less than, equal to, or greater than the sum of the benefits to be realized. In the case of the Denison Project, this was a long and laborious process—one in which numerous federal agencies assisted as consultants. The desirability of conservatism in applying a dollar-and-cents evaluation to benefits is apparent, and the application of this principle will be noted when figures are given later in this paper.

Investigations of the Denison Project included detailed computations of both cost and benefits on three different bases: (1) as a flood control project, (2) as a combined flood control and hydroelectric project, and (3) as a flood control project with provisions for the future installation of power generation facilities. These investigations led to the conclusion that the most favorable ratio of benefits to cost would be realized in the case of a project designed for both flood control and hydroelectric power initially. With the total cost of such a dual-purpose project determined, it is possible to allocate to each of these purposes certain portions of the total cost and likewise to determine the benefits allocatable to each of these purposes.

Two Types of Flood Control Benefits

Under flood control, we may classify the benefits under two general headings, as (1) direct or tangible, and (2) intangible.

Before attempting to evaluate the direct benefits of flood control in the Red River basin, let us examine briefly the characteristics of this valley. Periodic floods have caused extensive damage in the past, the most damaging ones being those of 1843, 1878, 1892, 1908, 1915, and 1935. Authentic records are available for only the last three, but historical records indicate that the 1843 flood was the largest, with an estimated peak discharge of 600,000 cu ft per sec at the Denison Dam site and an estimated runoff volume of over 4,000,000 acre-ft. With respect to areas affected by floods, the basin may be divided into three parts: (1) the basin above Denison, (2) the area between Denison, Tex., and Alexandria, La., and (3) the area from Alexandria to the mouth.

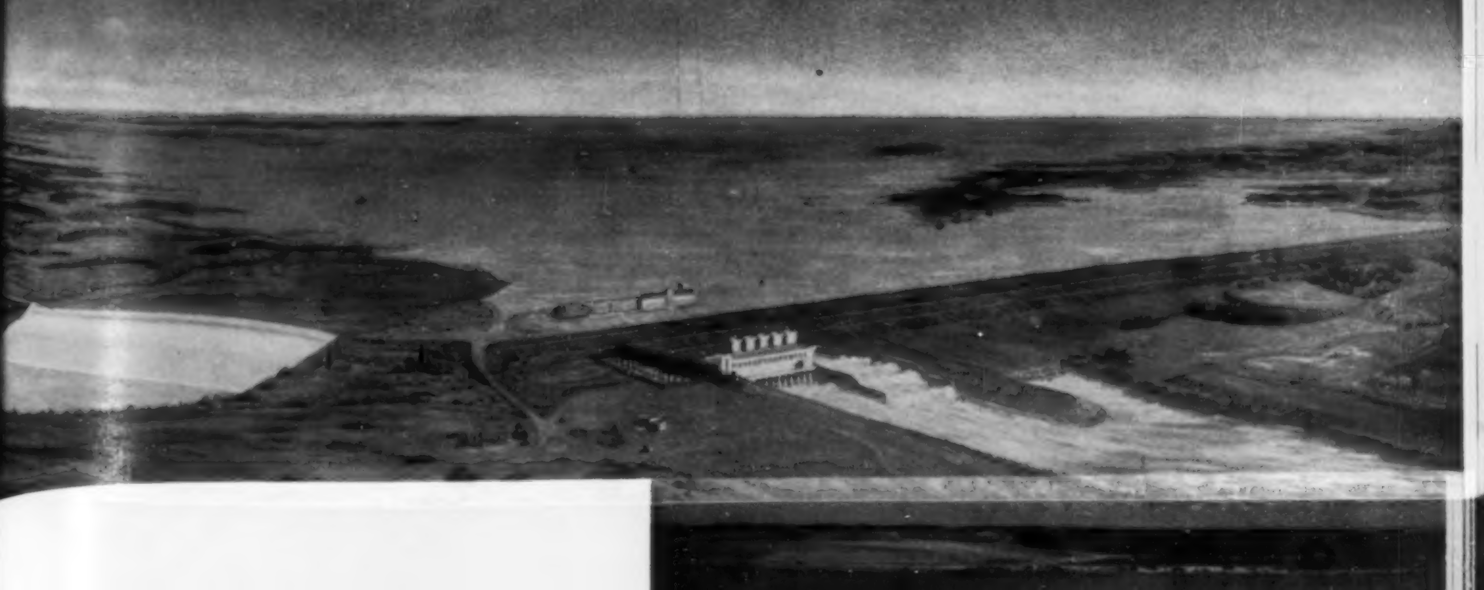
In the basin above Denison, the damages caused by floods are not great, since the amount of land innundated is relatively small and damage is unimportant when compared with that in the area below the Dension Dam. In the section between Denison and Alexandria, the flood problem becomes acute. The river bottomlands are practically all under cultivation. These lands vary from 2 to 4 miles in width, embrace over 1,672,000 acres, and include numerous small towns. When flooding occurs, the economic life in this part of the valley is seriously affected, and the fertility of the land is greatly impaired. About 610,000 acres in this region have been partially protected by levees and drainage systems at a cost of over $10,000,000.

Below Alexandria, the bottomlands are flooded by the backwaters of the Mississippi River. In this region, about 830,000 acres have been protected by local interests with levees and drainage systems. Flood damage surveys were made in the Red River basin after the floods of May 1930, May 1935, and February 1938. Estimates prepared from these surveys showed that the benefits which would have accrued from the Denison Project, had it been built, would have been approximately as follows:

1930 flood,	$3,500,000
1935 flood,	$8,500,000
1938 flood	$750,000 crop benefits $900,000 total benefits

Computations have been made to determine the amount of damages that would have been saved during the 1908 flood, and the amount that would be saved during the

Artist's Conception of the Completed Denison Dam



Outlet Conduit Section Is Completely Encased in Concrete

maximum probable flood, by the building of the Denison Dam. These estimates were as follows:

1908 flood,	$10,500,000 crop damages
Maximum probable flood,	$17,250,000 total damages

The crop damage curve for Denison Dam and Reservoir appears in Fig. 1.

It is to be noted that these figures include only the damage during periods of severe floods; they do not include damages from smaller floods of greater frequency which inflict severe losses on the agricultural lands in the valley below Denison. In summary, the average annual direct benefits from flood control only are estimated at $1,600,000 per annum. This figure is approximately equal to the average annual cost of operation of that portion of the project allocated to flood control. It will be noted that, as far as flood control alone is concerned, the project is in economic balance without taking into account any indirect or intangible benefits, to which no value has been assigned.

Indirect Benefits Must Also Be Considered

Although not assigned a definite evaluation, the indirect benefits should not be slighted in considering the total benefits to be derived from the project. Indirect benefits would include such items as (1) a lessening of the disease rate, (2) decreased loss to general business, (3) decreased damages to public structures, such as bridges, roads, and public buildings, (4) the creation and improvement of recreational facilities, (5) lessening ravages from the cotton boll weevil, (6) better control of spread of weeds on farm lands, and (7) improvement in morale, due to removal of fear as to future flood damages.

In summarizing the benefits to be expected from the operation of the Denison Dam and Reservoir for flood control, it is found that 397,065 acres of cleared land between Denison and Alexandria will be protected from a flood equal to that of 1908, and 596,663 acres will be protected from the proposed maximum probable flood. Assuming that lesser floods will occur in accordance with past records, it can be seen that flood control operations alone should afford average annual tangible benefits through the reduction of flood damages amounting to approximately $1,600,000.

As previously stated, the annual costs of operation allocatable to hydroelectric power are computed as the difference between the total annual cost and the annual cost allocatable to flood control. Considering the economic life of the project to be 50 years, with average interest at $3^1/_2\%$, it is found that the total average annual cost of operation for both flood-control and power generation will be approximately $2,500,000. As has been shown, the average annual tangible benefits to be realized from flood control alone amount to approximately $1,600,000. It is therefore evident that a minimum of $900,000 gross revenue must be realized from the sale of power.

At the request of the Engineer Department, the Federal Power Commission, through its Bureau of Engineering, has completed a study of possible markets and the probable sales value of power that might be developed at the Denison Project. The Bureau analyzed the past and present uses of electric energy in an area considered sufficiently large to comprehend all market possibilities available to the project, factors effecting use of energy in the area, present power facilities, characteristics of area loads, probable future power requirements, and the total potential value of Denison power for various installations and with various market assumptions.

Practically all generation in the region is by steam-electric plants. The Bureau found the total requirements of the area to be large in proportion to the energy available from the project. In short, it is concluded that the project output could be disposed of immediately upon its completion for use as replacement energy yielding a gross revenue equivalent to the resulting saving in cost of fuel plant operation, with an ultimate capacity value dependent upon load growth in the market area. The ability of the project to carry a definite portion of the peak capacity requirements of the area will obviate the need for additional capital investment in new plants. Thus, the installation of peak facilities at the Denison Dam must be governed by the capacity of the market to absorb the energy output of the project during its useful life at a rate exceeding the cost of production.

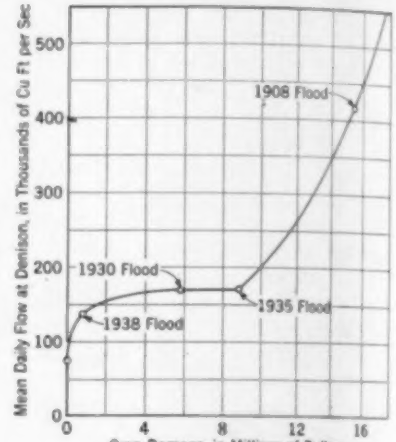
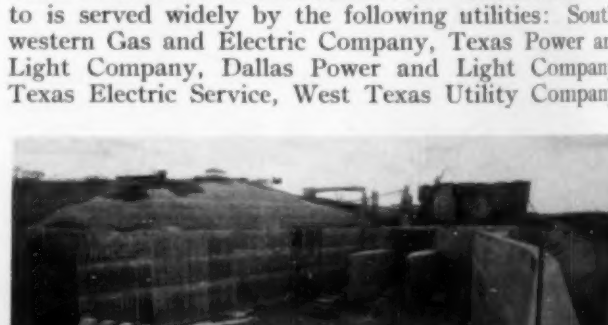


Fig. 1. Crop Damage Curve for Denison Dam and Reservoir

The Denison Dam is located in a growing area with a population of more than 6,150,000 persons within a radius of 200 miles (1930 census), and with a rate of growth which was 3% higher than the average for the United States between 1920 and 1930. The area referred to is served widely by the following utilities: Southwestern Gas and Electric Company, Texas Power and Light Company, Dallas Power and Light Company, Texas Electric Service, West Texas Utility Company



Completed Stilling Basin Has Staggered Teeth to Help Dissipate Energy

Fig. 2. Map Showing Results of Power Market Study in Denison Dam Area

Oklahoma Gas and Electric Company, and Public Service of Oklahoma. The total installed capacity of these companies is approximately 800,000 kw, each company being interconnected with at least one other system. Nearly all the installed capacity is in fuel-generated plants (Fig. 2). The total energy requirements in the area in 1935 aggregated 2,304,000,000 kwhr. The Federal

Completed Portal Wall and Paving in Power-House Area

Conduit Section Nearing Completion

Power Commission predicted a demand for 3,329,000,000 kwhr in 1940; 4,136,000,000 in 1945; and 5,101,000,000 in 1955.

During the years that have elapsed since 1935, actual experience indicates that additional required energy will be at least equal to, if not greater than the prediction of the Federal Power Commission. The Commission determined the annual load factors within the area and applied these to determine power output requirements. This study indicated that there would be a deficiency in the area in 1940 of 18,800 kw and in 1955 of 315,400 kw. Additional power to meet deficiencies at peak-load requirements will presently be supplied with purchased steam-generated energy secured from outside the area.

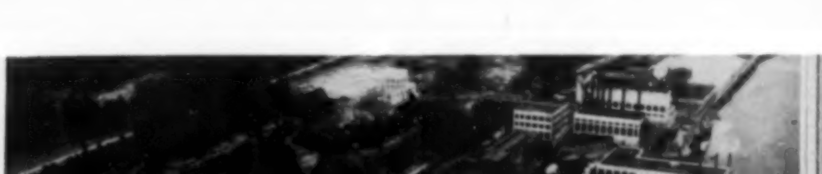
MARKET FOR POWER CLEARLY ESTABLISHED

Investigations indicate that the area will require at least 45,000 kw additional capacity at about the date on which power can be made available at the Denison Project. Since project plans provide for the initial installation of two generator units only, with provisions for an ultimate installation of five units when the market for the additional power has arisen, it is apparent that the market for the power to be generated at the Denison Dam has been clearly established.

With the ability of the market to absorb power from the dam thus determined, it is necessary to determine the value of the power in evaluating the proposed installation. The Federal Power Commission investigated 10 of the major steam electric plants within the area of the Denison Dam having a total installed capacity of 435,700 kw and generating in 1935, 1,931,201,240 kwhr. The cost of production at the switchboard was found to range from 1.0 to 3.64 mills per kwhr, an average of 2.29 mills per hr, exclusive of fixed charges. The value of the power output of the Denison Project is, as has been explained, that of the equivalent steam power. From this study it would appear that a demand charge of approximately $11.00 per kw and a minimum energy charge of 1.5 mills would be reasonable.

With an initial installation of 75,000 kw and with the output of the ultimate of five units absorbed within 15 years, the average annual revenue from Denison power would be $1,417,000.

In conclusion, we find that the average annual benefits from flood control, through the reduction of flood damages, total $1,600,000. We find that there are numerous indirect and intangible benefits not susceptible to monetary evaluation. We find that the average annual gross revenue for power should be approximately $1,400,000. Benefits, both from flood control and power, thus amount to $3,000,000, which, when compared to the average annual operating cost of the complete project of $2,500,000, leaves approximately $500,000 on the right side of the ledger.



Model Tests for Navigation Lock at Oregon City, Ore.

By A. E. Niederhoff, Assoc. M. Am. Soc. C.E.
Civil Engineer, U.S. Engineer Office, Portland, Ore.

A PROPOSED high-lift navigation lock for shallow-draft vessels will soon replace the 71-year-old locks at Oregon City, Ore. Unique in several respects, this new aid to navigation on the Willamette River is a result of the Flood Control Act of 1938 and will be started as soon as funds are made available by Congress. Preliminary surveys, design and model studies have developed special baffles to decrease turbulence. This feature, necessary because of the small craft using the lock, is here described by Mr. Niederhoff.

MOST Oregonians are familiar with the 50-ft falls in the Willamette River at Oregon City, just 13 miles south of Portland. This potential water power attracted early settlers to the site in 1830, but the falls impeded navigation—the one sure means of transportation for pioneers and their goods. Various schemes were tried by private companies to circumvent the falls but it was not until 1870 that the Willamette Falls Canal and Lock Company started construction under authority of the State of Oregon. The canal and four lock chambers were hewn out of the hard rock alongside the falls on the west bank of the river. This early construction, with hand-operated gates and filling devices, can still be seen in operation from the highway bridge crossing the Willamette River at Oregon City. Tolls were charged for the use of the locks by the various owners until July 8, 1913. At that time the United States acquired the property by deed from the Portland Railway Light and Power Company for a sum of $375,000, of which the State of Oregon furnished $300,000. The national government rehabilitated the locks and has been operating them toll-free ever since.

The old lock, built seventy years ago, is something of a museum piece with its obsolete, hand-operated machinery and stone masonry walls. The walls are not very high—just high enough to provide a foot of freeboard above the water surface in the chambers. Old timers, however, did use expert craftsmanship in fitting the loose stones into a wall. It was a long, tedious process beginning with quarrying the stone in the vicinity of Carver, Ore., and barging it 10 miles down the small, winding Clackamas River for delivery at Oregon City. The greater part of the year the crooked Clackamas is not navigable because of low water. Deliveries necessarily were made only in the winter and spring months.

With consummate skill the craftsmen mitered the stones into the walls so that today they still stand in spite of the fact that the bonding mortar has to a considerable extent leached away. Even the ironwork anchoring the lock gates was carefully selected, and compares favorably in point of strength with the structural steel produced today. Tested specimens showed a tensile strength of 52,000 lb per sq in. after having been in use for nearly three-quarters of a century. The materials that went into the construction of these old locks, except for the wooden gates, have not worn out.

The design for the new navigation lock provides for its use by log rafts, barges, and boats drawing not more than 8 ft of water. The entire fall of 50 ft is to be made in one step through an enlarged lock chamber, instead of in the four steps now used. Difficulty is anticipated in filling the lock quietly enough to permit small craft to float placidly in the chamber during the inrush of water. If this inrush is not controlled, small boats may be swamped or dashed against the miter gates or walls.

In a high-lift ship lock, such as the one at Bonneville, Ore., the filling of the chamber can be done quickly and safely because of the cushion of water (26 ft) over the floor ports where water enters. This cushion serves to diffuse the entering jets, and boats riding on the surface are but little affected. Even there, however, passengers on the steamboat *Lake Bonneville* making scheduled

Model of Main Lock Being Filled at a Head of 47.6 Ft
Left, with Roof Panels Removed; Right, with Roof Panels in Place. Note Reflections on Surface, Which Indicate Quiet Filling

trips through the lock have remarked on the agitated, turbulent water surface during filling operations. At Oregon City, the cushion is only $9^1/_2$ ft, and loaded barges may have their bottoms within $1^1/_2$ ft of the floor. Obviously a new type of waterway structure was indicated to meet this problem safely and efficiently.

Careful study has been given to devising the filling system and floor ports so as to produce the most satisfactory conditions in the lock. A solution has been found that consists of putting a roof over the top of the floor ports. Without this roof, which is only 15 in. above the lock floor, the jets of water from the ports rise to the surface and cause a turbulent, unsafe condition. The roof turns the jets so that they exit in a horizontal direction and dissipate energy by opposing each other and by impinging upon the lock walls. The water will rise to the surface quietly and thoroughly diffused. The dampening influence of this roof has been amply demonstrated in model tests in a hydraulic laboratory.

Hydraulic model tests have indicated several other improvements. The necessity for providing a tapered floor culvert instead of one of constant cross section was immediately apparent. Tapered culverts force the water out of the ports in a uniform manner throughout the entire length, whereas a constant-section culvert probably would cause a preponderance of flow out of the end ports. A change in the direction of flow takes place only when outside forces act on the stream. In this case, throttling the culvert down toward the end serves to squeeze water out of the upstream ports about as fast as it flows from the lower ports.

It was distinctly necessary to provide a roof over the ports, as shown in the accompanying photographs of the model being filled. In the first case, a roof was not provided, with the result that boils or fountains of water pierced through the shallow cushion. In the second case, the placid condition obtaining with the same head but with a roof over the ports is clearly shown. These photographs tell the complete story.

To determine the relative hydraulic merits of the many experimental systems of waterways investigated, some means had to be selected to measure efficiency, feasibility, and adaptability. Moreover, the measure of these traits had necessarily to be subject to graphic presentation. Consistent results for many trials under the same conditions were, of course, another paramount need. To solve this problem, a tow of barges was duplicated to the model scale in the lock chamber. Recording devices measured the elevation of the water in the chamber, and the movement of the filling valves was also recorded. Incoming water tending to move the barges about the chamber exerted a force on a bellows arrangement mounted on the barges. The bellows on each barge forced a column of colored liquid to move up and down in a calibrated glass tube. The elevation of the liquid in the tube indicated both the magnitude and the direction of the pull. Motion pictures of fluctuations of the liquid columns were later studied and accurately plotted with reference to time.

All these data were summarized on what is known as a "hawser stress diagram." On this one sheet, available for easy comparison with other diagrams to the same scale, and with a common time abscissa, are plotted 7 important factors: (1) tension upstream or downstream in a simulated hawser, (2) lateral tension at the bow of the tow, (3) lateral tension at the stern of the tow, (4) time required to fill the lock, (5) rate of rise of water surface in the lock, (6) movement of filling valves, and (7) fluctuations in the upper pool surface during filling.

While no claim can now be made that the model hawser stresses duplicate those in the prototype, it can at least

Entrance to Old Locks at Oregon City
Falls, Used for Power Development, Are at Right

be said that these stresses in the model are sensitive to changes in physical and hydraulic conditions. The validity of using hawser stresses as a criterion has been demonstrated time and again throughout the experimental work. A few general relations of model hawser stresses to other factors, based upon prototype units of measurement, may be of interest:

1. Hawser stresses increase directly with lock lift, other things being equal. For example, an increase of 25% in lift may be expected to yield hawser stresses 25% higher.
2. Hawser stresses increase with decreasing depth of "cushion water." The indicated dampening effect varies inversely as the 0.3 power of the depth of the water cushion.
3. Hawser stresses increase with increased projected area of barge bottoms moored in the chamber. The exact variation could not be determined in these tests because of inconsistency in the few scattered measurements.
4. Hawser stresses increase with deeper barge drafts. The variation is proportional to the draft raised to the 5/4 power.
5. Hawser stresses increase with the rate of increase of area through the controlling valves. By accelerating valve operation the hawser stresses are increased.

Admittedly these relationships were determined from meager data collected from several tests of adaptations and modifications of one model lock. For that reason, Items 1 to 5 are submitted with some hesitation. If, however, they chance to be in substantial agreement with observations made by others it seems that a prediction of the magnitude of hawser stresses might in the future be made for any lock without the expense and time consumed in testing hydraulic models.

Types of navigation now using the existing locks are limited to barges, boats, and rafts not longer than 175 ft, nor wider than 37 ft. It takes at least an hour for a boat to make the passage from lower pool to upper pool. Under unfavorable conditions it has taken log rafts as long as $2^1/_2$ hours to get past the falls. The new locks are designed to pass log rafts 400 ft long and 56 ft wide in less than 30 minutes. This means that the present capacity will be increased about 10 times.

This factor is becoming increasingly important because of the large amount of traffic waiting to go through the present antique structures. In 1940, nearly a million and a half tons of cargo passed through the locks. Every effort has been made to increase the efficiency of the present locks. Three 8-hour shifts work every day and additional men have been added to each shift. Motors are used on some of the gates to assist and accelerate hand operation. These improvements account in part for the augmented carrying capacity during 1940. Modernization and improvement can go no further, however, and complete reconstruction will be required to meet the ever-growing demands of navigation.

Philadelphia Decides on Water Supply Program

Improvement of Present Local Supplies Chosen Instead of More Distant Source

By Nathan B. Jacobs, M. Am. Soc. C.E.
Of Morris Knowles, Inc., Pittsburgh, Pa.

An important decision about choice of a city's water supply can be an issue for many years. No doubt this is because the average man in the street knows that the life of his city depends on the water supply and he is aware of its quality. In a general way he is also aware of its cost. In this paper presented at the April meeting of the Philadelphia Section, Mr. Jacobs gives a graphic picture of Philadelphia's water supply problems and of the program decided upon for solving them.

In the series of events leading up to the development of the system which has supplied water in the city of Philadelphia for the past 30 years or more, there has been continuous evidence of difficulty in choosing between the utilization of nearby sources and the development of a more remote supply. This conflict of opinion appears to have existed not only between different groups but in the minds of the same persons at different times.

And although the program of filtration of the Schuylkill and Delaware rivers was only completed in 1913, a further report considering the advisability of continuing to obtain water from these sources or of developing an upland supply was submitted in 1920 by a board of consulting engineers. This board was composed of J. W. Ledoux, George W. Fuller, Joseph F. Hasskarl, and J. Waldo Smith, all Members of the Society except the last, who was an Honorary Member. The Board recommended the construction of the first impounding reservoir on the Perkiomen River and improvement of the existing Delaware and Schuylkill supplies.

In the light of past events, it is apparent that one very serious phase of the Philadelphia water problem has been the lack of a clear-cut, definite program of development, and, since the adoption of the supply system completed in 1913, the lack of a consistent policy of up-keep, maintenance, and improvement. Many factors may have entered into the recommendations

Fig. 1. Existing Water Supply Districts and Plants

made and the decisions reached on this problem, but the predominating consideration in the final choice of a filtered supply from local sources no doubt was that of cost. If it were not for the cost, there would be no question as to the advisability of selecting that source offering the greatest initial purity.

The idea of securing a supply having better initial characteristics than that from the local rivers has its appeal. And this would be true even if the final supply, as furnished in either case, were equal in all respects. However, the facts are that a safe supply can be taken from the two nearby rivers. This has been demonstrated. Other desirable characteristics such as potability, taste, odor, and appearance, although lacking in the past, can be achieved through utilization of improved treatment facilities. The question then is whether a supply from a more distant source is worth the additional cost to those who use it and must pay for it. The cost of

Original Philadelphia Water Works on Schuylkill River, Begun in 1799

Here Water Was Pumped Through a Conduit in Chestnut Street to Centre Square, Where It Was Repumped for Distribution

a supply from upland sources has been variously estimated at from $150,000,000 to $300,000,000. There is no doubt that this cost could and would be met if there were no other source available. However, following numerous studies and reports and after much consideration of the problem, the decision was made to continue to utilize the nearby sources but under conditions that would result in improving the quality of the finished product.

Emphatic approval of the bond issue in 1940 by the voters is evidence of the favorable public reaction to the decision of the Mayor and City Council to reject the idea of an upland source in favor of proceeding promptly with the improvement of existing facilities. The program as presented includes, in general, rehabilitation of the existing works and modernization of the supply facilities to furnish a water of satisfactory quality not only from a pathological point of view, but as to potability, taste, odor, and appearance; and improve-

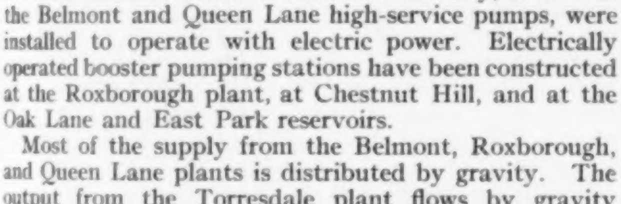
ment of the transmission and distribution systems, involving both pumping equipment and mains, to assure dependable service at adequate and uniformly maintained pressures.

The original units of the system, as developed under the 1899 program, have been continued in use, but certain adjustments have been made from time to time, such as the installation of rapid sand filters to replace certain of the original roughing filters and the substitution of electric power for steam in some of the pumping stations. The present purification facilities (Fig. 1) include the Belmont, Upper Roxborough, Lower Roxborough, and Queen Lane plants, which take their supply from the Schuylkill River; and the Torresdale plant which takes water from the Delaware River and furnishes about one-half of the total supply. Preliminary filters for pretreatment of the water prior to slow sand filtration are provided at the Queen Lane and Torresdale plants. The rated capacities of the five plants total approximately 400 mgd.

Queen Lane Reservoir Inlet Flume, to Be Replaced by a New Concrete Structure

Electric power has been substituted for steam in the operation of the Belmont raw-water pumping station, in the Shawmont station which furnishes raw water to the Roxborough filter plants, and in the raw-water station at the Torresdale plant. Steam operation has been continued at the Queen Lane raw-water station, and at the Lardner's Point pumping station through which the greater part of the output of filtered water from the Torresdale plant is distributed. The relatively small pumps that raise the water from the Torresdale plant for distribution in the northeastern section of the city, as well as the Belmont and Queen Lane high-service pumps, were installed to operate with electric power. Electrically operated booster pumping stations have been constructed at the Roxborough plant, at Chestnut Hill, and at the Oak Lane and East Park reservoirs.

Most of the supply from the Belmont, Roxborough, and Queen Lane plants is distributed by gravity. The output from the Torresdale plant flows by gravity through a large tunnel to the Lardner's Point pumping station, where pressure is supplied for distribution. A relatively small proportion of the output from the Belmont plant is pumped for distribution in a high-service district. Part of the water coming from the Upper Roxborough plant, the Queen Lane plant, and the Oak Lane Reservoir, which is supplied from Lardner's Point, is repumped for distribution in the Chestnut Hill, Roxborough, and Tri-Service districts. A very small proportion of the supply produced by the Torresdale filter plant is repumped for distribution in the northeastern section of the city. The booster station at the East Park Reservoir is utilized to augment pressures in the high-value downtown districts at certain times, and is available also to furnish water during emergencies to the area west of the Schuylkill River, which is normally supplied from the Belmont plant.

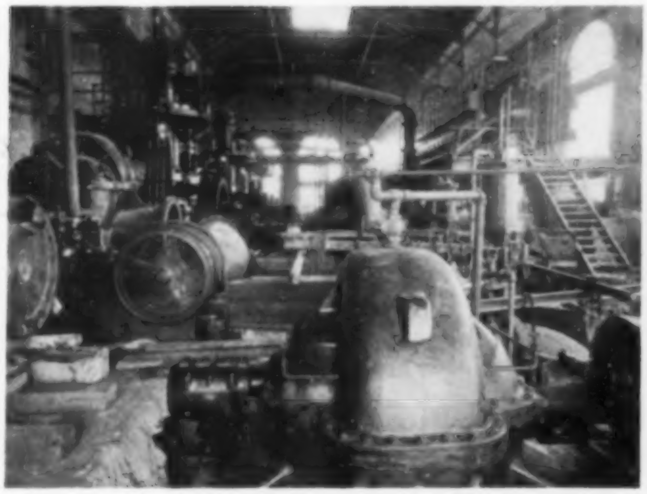


Old Centre Square Water Works, Philadelphia
Here Water from Schuylkill River Was Repumped for Distribution

Many of the smaller distribution mains were in place when the present supply works were constructed but numerous extensions have since been made to serve newly developed territory, and in many instances larger mains have been installed in strategic locations to reinforce the system and to provide better pressures for distribution. Supply mains to the various districts were constructed in connection with the filter plant and pumping station improvements, and a high-pressure fire system, including separate pumps and distribution lines, has been installed for the protection of the congested and high-value districts of the city.

As shown in Fig. 1, the city is now divided into ten districts for the distribution of the water supply. One of these districts receives a combined supply from the Upper Roxborough, Queen Lane, and Torresdale plants. Of the remaining nine, two receive their supply from the Belmont plant, one from the Queen Lane, three from the Roxborough plants, and three from Torresdale. Pressures for distribution at the higher elevations, where water cannot be supplied by gravity, are provided by pumping stations at the Belmont, Roxborough, Queen Lane, and Torresdale plants. All the water supplied through the Torresdale filters must be pumped for distribution and this is done at the Lardner's Point pumping station. Booster stations are located at the Oak Lane and East Park reservoirs, and in the Chestnut Hill district.

Water is supplied to the Oak Lane Reservoir from the Torresdale filter plant through the Lardner's Point pumping station. A portion of the supply goes by gravity to the area south of the reservoir and the remainder is distributed through the booster-pump station to the district served also by a high-pressure supply from the Roxborough and Queen Lane plants. The East Park booster pumping station serves the central



BEFORE ELECTRIFICATION ORIGINAL TORRESDALE RAW-WATER PUMPING STATION WAS CROWDED WITH MACHINERY

business section of the city at times when an increased supply and higher pressures become necessary because of high draft. It is also available to furnish an emergency supply to the area west of the Schuylkill River, which is normally served by the Belmont plant.

The total capacity of the basins that are available for the storage of filtered water is approximately 900 million gallons, or the equivalent of slightly less than three days' supply under average conditions. The available storage for filtered water will be increased substantially by utilizing the sedimentation basin at the Upper Roxborough plant as a distribution reservoir.

The rehabilitation of the purification works, as planned, includes the construction of modern-type coagulation and sedimentation basins and improved chemical and mixing facilities so as to provide adequately for pretreatment of the water prior to filtration; for the construction of modern rapid sand filter plants to replace the somewhat antiquated and inefficient roughing filters; the adoption of a policy of double filtration for the entire supply, utilizing the existing slow sand filters as final or polishing units for the effluent from the rapid sand filters; the installation of suitable equipment and treatment facilities for overcoming tastes and odor difficulties when they occur; the installation of more modern and improved chlorination equipment susceptible of accurate control; and adjustment of intake structures and raw-water pumping stations to provide additional capacity, economical operation, and uninterrupted service.

In addition to the adoption of double filtration for the purification plants, the improvements proposed in the system include the adjustment of existing facilities, construction of new pumping stations, and some rearrangement of the distribution districts—all designed to provide more reliable service, better pressures, and economy of operation. The most extensive changes will be in the Lardner's Point pumping station and in the rearrangement of the distribution districts supplied from the Torresdale plant.

The existing 93-in. steel main between the Torresdale filters and the Lardner's Point pumping station will be used for low-service distribution, and the low-service district will be extended north along the Delaware River. Also, the central business district and areas to the south, which are now supplied with low-pressure service from the Queen Lane plant and with high-pressure service from the Lardner's Point station, will get low-pressure service from the Torresdale plant, and a connection will be made to the East Park Reservoir, which has a capacity of 689 million gallons. This rearrangement of the low-service district does not mean that lower pressures will be furnished in the central business district and South Philadelphia. Under the new plan the same pressures will be available but they will be more uniformly maintained under varying conditions of demand because of the ample storage available in the East Park Reservoir and the additional pipe-line capacity to be provided.

The changes proposed will result in important improvements in services and economies in construction and operation, some of which are:

1. The low-pressure pumping equipment will not be required to meet the maximum hourly demands because of the storage available in the East Park Reservoir. This will be advantageous not only because of the smaller pumping capacity required but also because of the improved operating characteristics of the pumps.

2. Material savings in power cost will result through increasing the area included in the low rather than the high-service district.

3. Improved facilities will become available for extending service either from the Torresdale or Queen Lane plants at times of high demand, or for reducing operating difficulties in either system.

4. A greater proportion of the supply will be taken from the Delaware River, the water of which has better physical characteristics than that from the Schuylkill, and the flow of which is greater.

The high-service district will continue to be served by the pumping station at Lardner's Point, the water being supplied to the pumps as at present by gravity through the existing tunnel from the clear-water reservoir at the Torresdale filter plant. New motor-driven pumping units will be placed in one of the two buildings now housing the steam pumps, and improvements of a general nature will be made. A more extended area in the northeastern section of the city will be supplied from this station, and booster service will furnish water to the higher elevations. The area north of Pennypack Creek will be supplied from high-lift pumps to be located in the Torresdale pumping station, additional units being installed as needed to meet the requirements of extended development in this district.

Improvements in the mains of the distribution system are designed to provide better pressures, to replace lines that have given considerable trouble from breakage

TORRESDALE RAW WATER PUMPING STATION AFTER ELECTRIFICATION WITH INSTALLED CAPACITY OF 300 MGD

and corrosion, to replace mains that have become too small, to eliminate dead ends, and to provide for extensions into newly developed territory.

The average amount of water supplied daily to the system in 1940 was 321.6 million gallons. The maximum for any one day was approximately 400 million gallons. The present use of water is about 166 gallons per capita. In estimating the probable future demand, recognition has been given to the fact that the maximum per capita consumption in Philadelphia was reached as long ago as 1903. Since then, water waste surveys and the installation of meters on about one-half of the services have reduced the per capita consumption as the population increased so that the total demand now is but little greater than it was in 1903.

View of Lardner's Point Pumping Station in 1909
Then Considered One of the World's Largest of Its Kind

In the development of design requirements, it has been considered prudent to assume that progressive metering of all present flat-rate consumers in the city will continue; that regular surveys of the distribution system, to curtail waste and to anticipate and locate leaks in the mains, will be adopted as a routine procedure; that better control of public fire hydrants will reduce waste; and that a type of meter rate schedule, with charges specifically adapted to the conditions, will be adopted.

Reference to the meter schedule does not imply an increase in rates, or an increase necessarily in water works revenues, but an arrangement of charges that will tend to curtail waste without restricting reasonable use. A proper schedule will lower the expense of the Water Bureau by reducing waste and will pass along to consumers the savings thus effected.

A most important consideration in connection with complete metering of the supply and the control of waste through other methods is the reduction in average per capita consumption which past experience has shown will be realized. The studies made indicate that under such conditions the total supply required for the estimated population in 1965 will not be measurably greater than the present demand. This, from a design point of view, means that purification, pumping, and distribution facilities necessary to meet present-day maximum requirements will continue to be useful for a long time, with only minor adjustments in the smaller pumping units.

Steel Force Main 93 In. in Diameter
To Carry Water from New Torresdale Filtered-Water Pumping Station Now Under Construction

While it may be prudent engineering to base design capacity on reduction of waste and a 100% metering program, the effort required for its accomplishment cannot be minimized; it will require as much effort as will any part of this water works improvement program. The necessity of curtailing waste has been brought out in practically every report since 1910. This problem is not engineering alone and must have the concerted support of all civic-minded bodies.

The troublesome phase of Philadelphia's water problem has been to determine the source of supply. Doubt and indecision have prevailed as to whether the vastly greater outlay of money for the development of a more distant source might not be advantageous. This uncertainty has served more and more to make difficult the utilization of the river supply to best advantage. Improvements that otherwise would have been made, have not been carried out and a progressive policy of upkeep and maintenance has not been possible. But this difficulty should cease now that a definite decision has been made, money has been voted, and plans are in process of development for the letting of construction contracts.

Improvements have been designed to care for the anticipated needs of the city for a period of about 25 years in the future. This estimate, however, is based on the assumption that definite steps will be taken to eliminate waste. The first part of the problem, therefore, has been solved. The success of the second, which covers the problems of design, construction, and operation, will be greatly enhanced if the decision is universally accepted, a consistent and progressive policy adopted, and the united support of all concerned given to insure accomplishment of maximum results. The combined weight of public opinion will be most effective if pointed toward:

1. Abating the present pollution of the Delaware and Schuylkill rivers and prevention of any addition to or enlargement of the wastes, both municipal and industrial, now reaching these streams.
2. Support for the movement being put forth by civic bodies demanding universal metering.
3. Support for the Bureau of Water in its program of prohibiting the unauthorized use and abuse of fire hydrants and of continuing waste and leakage surveys throughout the system.
4. Adequate appropriations in the budget for technical personnel to operate the new filter plants when built and to maintain the entire system.

Engineers' Notebook

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Automatic Infantry Combat Target

By A. George Mallis, Jun. Am. Soc. C.E.

Second Lieutenant, Construction Division, Quartermaster Corps, Fort Jackson, S.C.

It has been apparent to military personnel for some time that the present targets used to train troops in the use of arms under simulated combat conditions have not been entirely satisfactory. In combat target firing, the enemy is represented by silhouettes, each target representing the upper half of a man. Troops advance upon the area in which the targets are located, and attack them by rifle fire and movement, as they would an actual enemy. At the present time two general methods are in use for placing these targets in the field, the "fixed" and the "movable" method.

Fig. 1. Silhouette Targets Mounted on Electrically Rotated Steel Beam

(*a*) 20-Ft Steel Beam, (*b*) 1-In. Cold Rolled Steel Shaft, and (*c*) Journal Bearing Mounted on Concrete Base

In the fixed method, the silhouette targets are attached to wooden staves which in turn are driven into the ground at any desired location. The advantages of this method are the ability to change the location of the targets at will, and the elimination of apparatus for the operation of the targets. The inability to expose and conceal the targets at will is its chief disadvantage, because the advancing troops can see the targets long before they are in position to open fire. As a result practically all the element of surprise is eliminated from the exercise.

In the movable target method, the silhouette targets are placed on standard ordnance frames. As these frames are manually operated, concrete emplacements are necessary for the protection of the operators. Instructions for the operation of the targets are telephoned to the operators by the officer conducting the training exercise. The advantage of this method is the ability to expose and conceal the targets at will, thus achieving a greater element of surprise. Its two disadvantages are the fact that the emplacements can be observed by the troops, and the necessity of having target operators.

Considering the disadvantages of both methods, the writer has for some time been working on the development of an electrically operated combat target that would achieve complete surprise, and yet entail no overhead in the way of numerous operators. Recently the writer, working with F. G. Franklin of the Constructing Quartermasters' Office, Fort Jackson, S.C., has developed just such a target.

In general, this new target assembly consists of a steel beam on which eight silhouette targets are mounted (Fig. 1). Welded to each end of the beam are steel shafts which act as axes of rotation. These shafts rotate in babbitt bearings which are securely mounted on concrete bases. A large sprocket wheel is placed on one of these shafts, and by means of a chain drive from an electric motor, the beam is made to rotate. Underground wires lead from the motor to a pushbutton station at the central control point. The whole assembly is mounted below the surface of the ground, and until the targets are exposed nothing is visible above the ground. Also, because of the electric operation, one man back at the control point can operate any number of target assemblies.

Motive power to the beam carrying 8 silhouette targets is supplied by a $^1/_3$-hp 3-phase, 220-v, reversible electric motor. Initially the motor has a speed of approximately 1,700 rpm. This speed is reduced to 24 rpm by a worm-and-gear arrangement incorporated within the motor assembly. Final reduction to 3 rpm is obtained with the sprocket arrangement. It was found by experience that approximately 3 rpm gave the best time for raising and lowering the targets. The motor is started and stopped by pushbuttons located at the control station. This station may be as far as 1,000 yd from the motor. In using such a distant control point, a magnetic control box had to be used near the motor. A pair of limit switches is used to stop the beam in its proper horizontal or vertical position. In addition to controlling the beam, these switches act as a safety measure for the motor. This safety precaution is used in case the pushbutton control should fail to stop the motor, in which case these limit switches would stop it before the beam pressure against the earth overloaded the motor. The limit switches are actuated by a cam located on the live end shaft.

This target proved very successful in its early tests and later was adopted for use on the new half-million-dollar Fort Jackson rifle range.

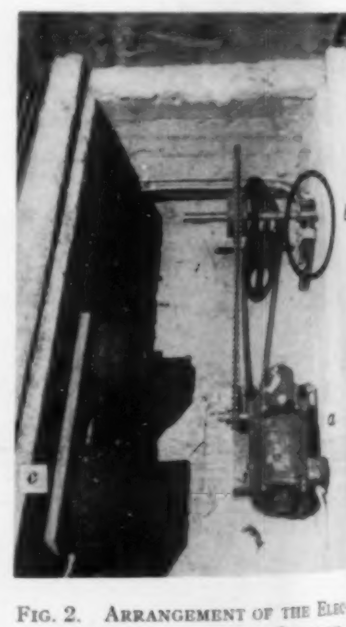


Fig. 2. Arrangement of the Electrical Assembly which Operates Targets by Remote Control

(*a*) Electric Motor, (*b*) Limit-Switch Assembly, and (*c*) Control Box

Chart for Determining In-Place Density of Soils

By R. E. Pidgeon *and* P. W. Warren

Respectively Assistant Regional Forester and Associate Civil Engineer, U.S. Department of Agriculture, Forest Service, Atlanta, Ga.

During the past year, the Southeastern Region of the U.S. Forest Service has had under construction several earth dams to develop recreational lakes. The materials used are mostly fine-grained, plastic soils necessitating rigid density control in order to ensure the required stability. The material is compacted with sheepsfoot rollers while it is within established limits of moisture content. Frequent in-place tests are made to ensure that the density meets the requirements established for each particular soil.

In making the in-place density test, the hole from which the sample has been taken is filled with sand of a predetermined density. Since the weight of the sand used (weight before filling hole less weight after filling) is known, the volume is obtained and divided into the weight of the sample removed to find the density of the material in place.

In order to facilitate the computations, a chart, Fig. 1, was developed from which the in-place density could be read within the limits of control practical on the average construction job. The known factors are the weight of the material removed, the weight of the sand used in filling the hole, and the density of this sand. Using these factors, the chart is read in the following way. From a point on the left-hand scale representing the weight of the sand used to fill the hole, a horizontal line is extended to its intersection with the diagonal line which represents the dry density of the sand. Through this point a vertical line is extended upward to its intersection with another horizontal line. This second horizontal line starts from the point on the left-hand scale that represents the weight of the material removed from the hole. The nearest diagonal line to the intersection of these last two lines represents the wet density in pounds per cubic foot. If the control is based upon dry density, the material removed may be dried before weighing, or the moisture content of a portion of it may be determined and the net weight corrected accordingly.

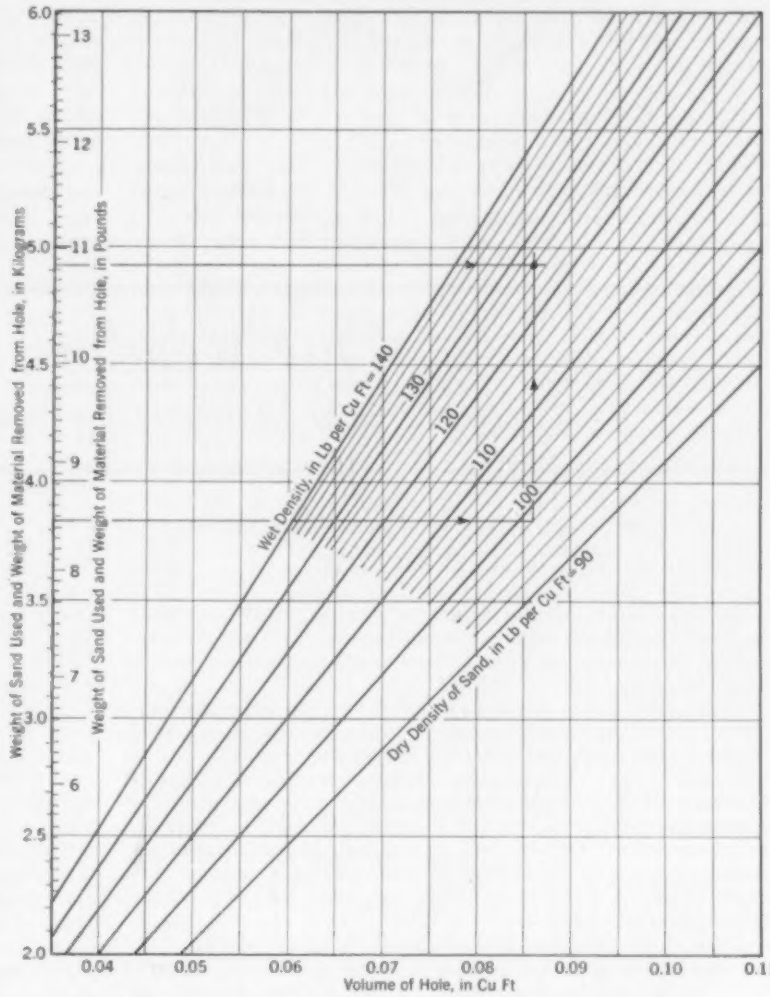


Fig. 1. Chart for Determining In-Place Density of Soils

An example has been worked out on the chart, Fig. 1. In this case the weight of the sand used was 3.84 kg (8.46 lb) and the lower horizontal line starts at this point in the left-hand scale. The upper horizontal line starts at the point representing the weight of the material removed from the hole, 4.92 kg (10.85 lb). The lower horizontal line intersects the diagonal that represents the dry density of the sand (98 lb per cu ft), and from this point of intersection a vertical line is drawn upward to intersect the upper horizontal line at the diagonal representing 126 lb per cu ft—the wet density of the material removed from the hole.

The Effect of Wind on Rainfall

By F. B. Marsh, M. Am. Soc. C.E.

Division Engineer, Eastern Department, New York City Board of Water Supply, White Plains, N.Y.

The wide variations in rainfall and runoff that may be caused by the wind where the topography is rough are not generally appreciated. Assume that *AB* and *CD* (Fig. 1) represent two level plains with a deep valley, *V*, in between. To simplify the problem, assume the side slopes *BV* and *CV* at 45° and their horizontal projections the same as *AB* and *CD*.

With a given rainfall dropping vertically, the total rainfall on the two flat areas and on the two valley sides would all be the same; but consider what happens when the wind blows from the left just enough to make the raindrops fall at a 45° slope. The total falling on *AB* and *CD* remains the same, *BV* gets none, and *CV* gets twice that on *AB* or *CD*. This is true even though the rainfall

recorded by a rain gage on any of the four areas would be the same (the rain gage is assumed to be set with a level top several feet above the ground surface in each case).

FIG. 1

This is one reason why mountain streams are bound to be more flashy, with greater flood flows, than streams in a flat area of the same size. The windward side of a mountain always gets more rain than the other, even though the rainfall may be recorded the same on both sides. Incidentally this explains why we sometimes get water in the cellar from a long-continued storm. If the windward wall of the house were twice as high, we would theoretically get twice as much water in the cellar.

As a corollary to this it may be of interest to look at Question 2 of the quiz on page 93 of the August *Reader's Digest:* "If you're out in the rain for five minutes, will you get wetter walking or running?" The answer they give on page 123 is, "If you are out in the rain for any given length of time, you'll get less wet walking and least wet standing still."

That is correct on the assumption that the rain is falling vertically. If the wind happened to be blowing, you would get least wet by going with the wind and at the same speed.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Engineering Difficulties in Latin America

To the Editor: In the September number, Fred Lavis gives an interesting picture of the commercial situation in Latin America. It must be borne in mind that business south of the Rio Grande is done differently from in New York.

About two decades ago when World War trade restrictions and shipping were beginning to return to normalcy Central and South American merchants had docks and warehouses jammed with produce awaiting export to an eager, high market outside. The stuff had been taken in trade, and now shelves were empty—it was apparently a seller's Eden. Still unable to promise deliveries, European representatives could do nothing but dourly watch the American financial and mercantile men, locally ignorant of safe credit practices, grabbing recklessly poor risks that were to give them long-time headaches.

I had an interesting assignment just then. An American utility corporation had engineers in one of the Central American republics to determine whether it would pay to take a national power concession. The whole territory had but one electric plant, an inefficient wood-burning device for the capital city; a few small private gasoline electric plants to run movie halls; and an occasional small water-power plant on plantations or at gold mines in the mountains. Our tentative plan was a conventional central plant near the metropolitan city of 50,000, with further transmission lines to the neighboring cities and towns.

We were courteously received. We found that a crude irrigation dam, made of laid-up quarried volcanic sandstone, could be rebuilt to a higher level as a main source of hydroelectric power. But the reservoir and watershed had insufficient storage and runoff for the still later expansion we envisaged. We'd have to have supplementary diesel-electric standby plants in each of the three larger cities. At this point the owner-builder of the dam, up to now enthusiastic about putting in his dam and reservoir for stock in the new company-to-be, balked. He would have nothing to do with any power source other than a hydroelectric system.

We explained, reasoned, and argued; there could be no other satisfactory system than a combined one we told him in a dozen different ways. Finally our persistence exhausted him to the point of making this classic confession:

"I'm sorry to make you gentlemen so much trouble; but you see just before the war began our city was about to make a contract with some German merchants for an all diesel-plant. I wanted to sell my dam and reservoir to the city for a new hydroelectric plant.

"Now I know my people well. So I broke up the Germans' chances. I worked on the councilmen separately and finally made a speech in an open meeting. They decided to give me the contract instead. But the war came—and anyhow I didn't know how to build a plant. So I was glad to work with you gentlemen. What did I say in my speech? Well I told them: 'You all know my father furnished the pipes and put in the water system we have that keeps us from the sicknesses we used to have. We as a family are very proud to have served you. And we feel obliged to go even further for our city's good. As you know I've traveled widely. And whether in Canada, the United States, or Europe, it's known everywhere that fire being red gives red electric lights, running water being white, white lights. Now we do not want our children's eyes spoiled by red lights.'"

Sure enough the gentleman knew his people! When he began urging that the combined red-white electric light system was necessary the councilmen recalled his lucid earlier explanation of quite a different nature. Incited, perhaps, by someone's German brother-in-law, they would have none of it, nor of us. His strange conversion was presumably attributed to the schemes and strange ideas of the two American engineers with whom he'd been consorting.

Other considerations caused us to report adversely for an investment in the republic; it is possible therefore that one of the new Import-Export Bank loans shortly to be made, or which may have been made, may be for a new hydroelectric system to make white lights down there.

Rochester, N.Y. RALPH Z. KIRKPATRICK

Computation of Flood Flows

DEAR SIR: The observations of A. H. Davison regarding the application of values of the coefficient of rougness *n* as presented in an article entitled "Computation of Flood Flows by Slope-Area Method," in the July issue, are informative and interesting. Mr. Davison states that an assumed value of *n* cannot contribute to an accurate solution. On the other hand, it would seem that a method of computation should provide a way for the application of judgment and experience in the selection of a value of *n* that is applicable to the given conditions of channel and flow in so far as the limits of accuracy of the other observational data will permit.

Reference to the plotting of the observed high-water marks (Plate 26, U.S. Geological Survey Water-Supply Paper 773E) indicates that the available information regarding the water-surface slope is not closely consistent and is subject to a variety of possible interpretations. Mr. Davison's solutions are based on the assumption that the slope of the water surface is essentially uniform through the two reaches. Anyone who has seen a steep natural stream in high flood will appreciate the weakness of this as a rigid assumption. Since other assumptions are possible and rea-

sonable within the limits of the observations, it seems unduly restrictive to apply this assumption in a way that limits the application of judgment and experience in the selection of a value of n suited to the observed conditions. If experience indicates that n has a value of the order of 0.035 or 0.40, the method of analysis should provide that due weight be given to this fundamental observed factor.

Mr. Davison proposes to apply an exact mathematical solution to data of such low precision as are usually available for slope-area determinations. Such a procedure may produce results that are seriously misleading.

In ordinary slope-area computations it is sometimes the practice to assume that the average friction slope in the reach is the average of the computed friction slopes at the two ends of the reach. This practice tends to give results for discharge which are smaller than the truth. This may be shown by analysis of flow in an expanding or contracting channel of given dimensions and with given cross sections of water at the ends of the reach, in which under the above assumptions as to slope, the discharge is computed, first, by using one reach and, second, by using several shorter subreaches. The first discharge is always less than the second.

The computation of discharge by the slope-area method is not well standardized, and it is possible that Mr. Davison's difficulty in checking other determinations of flood flow arises from this fact. Studies such as are presented in his article are helpful in working toward a better standardized practice.

Washington, D.C.

R. W. Davenport, M. Am. Soc. C.E.
Hydraulic Engineer in Charge, Division of Water Utilization, U.S. Geological Survey

Determining Flow Discharge

Dear Sir: The slope-area method of determining the flood discharge of a stream is never an exact method, even under the best conditions. For this reason the computation procedure proposed by A. H. Davison in his article, in the July issue, is unsuited for general practical use with this method as it requires a precision that is not justified by the base data.

The usual procedure is to select values of n for use in the Manning equation as a result of a first-hand field inspection of the selected reach of the stream. Mr. Davison considers that such a selection of n is unnecessary. In order to solve the problem, however, he is forced to assume certain relations between various n's and s's, stated in his Eqs. 2 and 3, the general applicability of which is open to question. After such assumptions are made the solution of the problem depends on the solution of a quadratic equation which can be expressed as:

$$\sqrt{s_{B1}} = \frac{\dfrac{4a_B n_1}{a_A^2} \pm \sqrt{\left(\dfrac{4a_B n_1}{a_A^2}\right)^2 - 4\left(1 + \dfrac{a_B^2}{a_A^2}\right)\left(\dfrac{4n_1^2}{a_A^2} - 2s_1\right)}}{2\left(1 + \dfrac{a_B^2}{a_A^2}\right)}$$

where $a = \dfrac{n}{s^{1/2}}$ and subscript 1 refers to reach 1—that is, A to B.

Mr. Davison no doubt computed his results with ordinary engineering precision. For the solution of this problem, however, that precision is apparently not sufficient. The differences between the terms under the radical are so small that at least four significant figures must be used in all computations. Obviously such refinements in computing are unwarranted by the nature of the base data, but that the method proposed by Mr. Davison involves such refinements can be seen by comparing the accompanying diagram (Fig. 1) with his Fig. 2. This diagram was obtained by using Mr. Davison's method, starting with the values of distance, water-surface elevation, A, and R, given in his Table I, for Glen Creek near Watkins Glen, N.Y., and carrying all computations to four significant figures.

Curves based upon both roots of the quadratic are plotted in the diagram. It will be noted that two roots were obtained for s_{B1}. The author's statement that "Single values occur in solving Eqs. 3 because the particular quantities are such that the radical becomes practically zero in the solution of the quadratic for n_B," involves an unjustified assumption. "Practically zero" has a quantitative significance in this case that is quite different from zero. In solving the quadratic for s_{B1}, the difference under the radical (that is, $b^2 - 4ac$) frequently obtained is only 5 units in the fourth significant figure of the two terms which might seemingly be called "practically zero," except for the fact that taking the square root results in the addition or subtraction of 2 units to the second significant figure of the term outside the radical (that is, $-b$). The effect of this on the intersections is to give discharges varying by almost 75% (8,600 and 15,000 cu ft per sec).

Mr. Davison has omitted other solutions of his problem which are just as likely as the one he presented. They are for the conditions that $n_A = n_B$, $n_B = n_C$, and $n_A = n_B = n_C$. Solutions for these conditions are also shown in the accompanying Fig. 1.

As a result of the refinement in computations dictated by the method, and consideration of all combinations that satisfy the assumed conditions, five values of the discharge varying from 8,600 to 19,100 cu ft per sec are obtained; but no solution is within 1,000 cu ft per sec of the author's solution of 17,800 cu ft per sec. If it is assumed that the quantity under the radical is zero in solving s_{B1} as was done by the author, a discharge of 12,000 cu ft per sec is obtained as compared with the author's 17,800 cu ft per sec, the difference being due solely to refinement in computations. The selection of the final discharge by this method may depend largely on the value of n which is believed from field observation to be most nearly applicable. Why not make a selection of n in the field in the light of judgment and experience in that procedure and base the computations on that selection?

It should also be noted that Mr. Davison has assumed a full recovery of the velocity head in the expanding reach B to C. Most authorities agree that this never occurs. Reduction in the loss of head assigned to friction in the reach B–C would have the effect of raising the intersections of all lines in the diagram and thus the final discharge.

Washington, D.C.

Wm. S. Eisenlohr, Jr., Assoc. M. Am. Soc. C.E.
Associate Hydraulic Engineer, U.S. Geological Survey

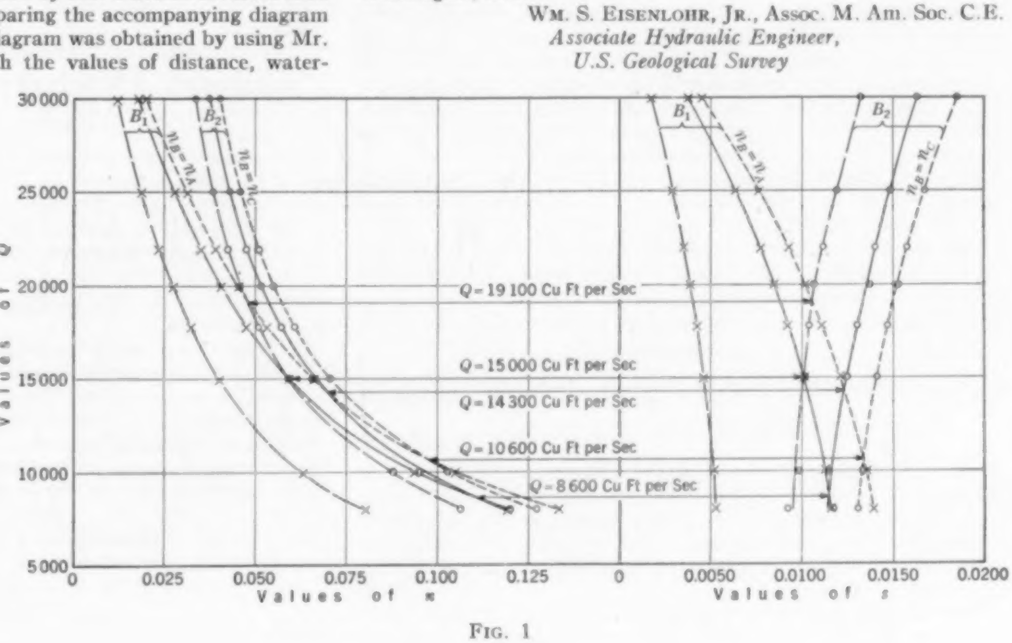


Fig. 1

The Early Antecedents of Soil Mechanics

TO THE EDITOR: The article, "The Study of Earth—An American Tradition," in the August issue, would give the reader a more adequate conception of the historical background of soil mechanics if Professor Baron had extended its scope both in space and time. The construction of the first railroads gave a powerful impetus to the study of earth in every civilized country. Even the first edition of the classical book by F. W. Simms on *Practical Tunneling* (London, 1844), based on observations during the construction of the first railroad tunnels in England, is still an inexhaustible source of information concerning the pressure of clay on timbering. A report made in 1841 by Robert Stephenson to the London and Westminster Water Company demonstrates that he had a clear conception of the influence of the permeability of sand on the diameter of the cone of depression produced by pumping from a well. In a pamphlet entitled "Recherches experimentales sur les glissements spontanés" (Paris, 1846), A. Collin states that the failure of slopes occurs by sliding along curved surfaces that have the characteristics of cycloids.

Thus almost every one of Professor Baron's citations could be matched by similar ones from long-forgotten European publications. Yet such an attempt would be idle, because there is ample evidence that the knowledge of the fundamental relations is very much older than the printed records. Roman engineers would not have attempted to transform swampy lowlands into good building ground without a working knowledge of the principles of consolidation. The ancient methods of mining through soft ground are based on an intuitive knowledge of the arching effect, and no Babylonian ditch digger even suspected that the distribution of the earth pressure on the timbering of cuts could be hydrostatic.

However, there are two categories of engineers who vigorously maintained until quite recently that the earth pressure on timbering can only be hydrostatic because Rankine's theory requires it, and to whom the concept of consolidation came as a surprise. The first includes those who, in a teaching capacity, prepared the younger generation for their professional activities. The other rather large group took what they had learned at school more seriously than what nature had tried to teach them on the job. The reactions of both groups to a quantitative statement of facts always known to experienced construction men can be learned from the discussions of some of my earliest papers. They were not very flattering. The reasons for the reactions were obvious. These engineers taught or tried to practice engineering science, and the science of soils had not yet achieved the modest goal, which it shares with other engineering sciences, of expressing our empirical knowledge in mathematical language.

The knowledge and experience stored up in the publications cited by Professor Baron and by the writer can be compared to the knowledge regarding the behavior of structures accumulated long before the theory of structures came into existence. The Gothic cathedrals of Europe were constructed without the assistance of the terminology and the methodology of applied mechanics, and when applied mechanics first appeared on the stage it met with stubborn resistance. Yet today no engineer would deny the vital function of this science in modern engineering.

In the middle of the last century the Harvard naturalist, Louis Agassiz, drew from his experiences the following conclusion: "Every great scientific truth goes through three stages. First, people say it conflicts with the Bible. Next, they say it has been discovered before. Lastly, they say they have always believed it." Soil mechanics is entering the second stage.

Cambridge, Mass. KARL TERZAGHI, M. Am. Soc. C.E.

Scientific Methods and Terminology in Studying Earths

TO THE EDITOR: Professor Baron's paper on "The Study of Earths—an American Tradition" in the August issue, appears to be based on the old adage that there is nothing new under the sun. Although he has presented material of some historical interest, I think he has "missed the bus" in failing to draw the proper conclusions from his data.

For example, there are several references to Gen. William Sooy-Smith, M. Am. Soc. C.E., in connection with foundation problems in Chicago, particularly the Chicago Auditorium. When this structure was built in 1887, General Sooy-Smith made the original borings and soil tests, and he helped to decide on the allowable soil load. By 1892, the settlement was 1.5 ft, and in 1898, about 2 ft. Other heavy buildings in Chicago were settling in a similar manner.

It is therefore not surprising that General Sooy-Smith should have arrived at certain conclusions about the behavior of deep beds of soft saturated clay. The surprising thing is Professor Baron's remark that General Sooy-Smith stated his conclusions "clearly" but "with no complex technical terminology." It is this very lack of technical terminology that constitutes the fundamental weakness of practically all of the literature of foundation engineering published before the rise of modern soil mechanics. Professor Baron appears to consider a technical terminology unnecessary. In the writer's opinion, a technical terminology and a scientific method are absolutely essential.

To illustrate this, reference is made to Sooy-Smith's foundation drawing on page 475. One of the soil strata is called "stiff mushy clay"—seemingly contradictory. Another is described as "soft wet clay easily forced by auger"; this needs amplification as to the size of the auger and the strength of the workman.

In modern technical terminology such soils can be identified wherever found. For example, the builders of Chicago's early skyscrapers were unable to profit by the experience of generations of European engineers simply because there was no scientific method of soil classification—soil of a new locality could not be compared with that of a region where years of experience were available. Such words as "hard," "soft," "stiff," and "mushy" are unquestionably simple and direct, but they are inadequate.

Professor Baron's search for "evidence" could have been carried back to the great Roman architect and military engineer, Marcus Vitruvius Pollio, who lived in the first century B.C. In stating his rules for constructing foundations under heavy temples, Vitruvius said (*De Architectura*, Book III) that the site should be excavated to solid ground and the foundations should be placed only on such ground. If the locality was soft or swampy, piles were to be driven and the foundations built on top of the piles. During the 2,000 years that elapsed from the days of Vitruvius to the time of Sooy-Smith, no adequate scientific method of soil classification was developed. After ten years experience with the auditorium, Sooy-Smith took Vitruvius' advice and put the post office on piles in 1898.

This is not to belittle the work of the pioneers. Nevertheless, I think Professor Baron puts the emphasis in the wrong place, by attaching too much significance to their simple direct language. He does not seem to appreciate that foundation engineering would be more nearly a science today if the pioneers had been able to go beyond simple direct language to a scientific method with a suitable technical terminology.

A. E. CUMMINGS, M. Am. Soc. C.E.

Chicago, Ill.

Spillway Discharge Coefficients for Madden Dam

DEAR SIR: I was interested in the article in the August issue by P. S. O'Shaughnessy, entitled "Conformity Between Model and Prototype Tests—Madden Dam Spillway."

The profession is indebted to Mr. O'Shaughnessy for his time and effort spent in preparing the results of these additional tests for publication. The results, except for spillway discharge coefficients, substantiate the previous tests reported in the paper by R. R. Randolph, Jr.

In regard to spillway discharge coefficients, the writer in a discussion of Mr. Randolph's paper (page 1121 of Vol. 103 of TRANSACTIONS) commented as follows: "However, the implication regarding coefficients of discharge for the spillway should not be overlooked. Judging from the results of others, whose methods of measuring discharge were superior to those described for Madden Dam, one is inclined to accept the model results at least for the maximum heads." It is evident from the later observations (see Fig. 5 of Mr. O'Shaughnessy's article) that the model continues to furnish the best indication of the spillway coefficients.

F. W. EDWARDS, Assoc. M. Am. Soc. C.E.
Senior Hydraulic Engineer, The Panama Canal

Diablo Heights, C.Z.

Fall Meeting in Chicago, Ill.

Palmer House to Be Headquarters, October 15–18, 1941

Program of Meetings, Entertainment, and Trips

Opening Session and General Meeting

WEDNESDAY—October 15, 1941—Morning

Red Lacquer Room

9:00 **Registration**

10:00 **Fall Meeting called to order by**

Robert I. RANDOLPH, *President, Illinois Section, Am. Soc. C.E.*, Chicago, Ill.

10:10 **Address of Welcome**

HIS HONOR EDWARD J. KELLY, *M. Am. Soc. C.E., Mayor of the City of Chicago*, Ill.

10:25 **Response**

FREDERICK H. FOWLER, *President, American Society of Civil Engineers.*

10:30 **Problems of Chicago Metropolitan Area**

W. W. DEBERARD, *M. Am. Soc. C.E., City Engineer*, Chicago, Ill.

11:00 **The Sewage Treatment Problem of Chicago, Historical and Descriptive**

HORACE P. RAMEY, *M. Am. Soc. C.E., Assistant Chief Engineer, The Sanitary District of Chicago*, Chicago, Ill.

11:30 **The Chicago Subway, Historical and Descriptive**

PHILIP HARRINGTON, *M. Am. Soc. C.E., Commissioner of Subways and Superhighways*, Chicago, Ill.

12:00 **Luncheon recess**

WEDNESDAY JOINT LUNCHEON

12:15 p.m.

At the close of the Wednesday morning session, there will be a joint luncheon with the Association of Commerce of Chicago in the Grand Ball Room, Palmer House

BRIG. GEN. BREHON B. SOMERVELL, *U.S.A., M. Am. Soc. C.E., Chief, Construction Division, Office of Quartermaster General*, Washington, D.C., will address the luncheon on

"Our Defense Construction Program"

Tickets for the luncheon are $1.00 each, but *they must be obtained in advance* from the Reservations Chairman, GEORGE B. MASSEY.

NATIONAL DEFENSE CONSTRUCTION

WEDNESDAY—October 15, 1941—Afternoon

Red Lacquer Room—Time, 2:30 p.m.

CHARLES B. BURDICK, *Vice-President, Am. Soc. C.E., Presiding*

The primary national effort today is to build the arsenal of democracy. Forty billions of dollars have been appropriated by Congress for ships and shells, camps and cantonments, factories and storage areas, far-flung ports and bases for air and naval craft.

This program is taxing the capacity of men and machines, money and credit, management and transportation. Especially is it dependent on the designing and management skills of engineers. Their part in the Defense Construction Program is the subject of this afternoon's Symposium.

2:30 **Building for the Expanded Army (Illustrated)**

COL. EDMOND H. LEAVEY, *C.E., U.S.A., M. Am. Soc. C.E., Chief of Engineering Section, Construction Division, Office of Quartermaster General*, Washington, D.C.

3:15 **Naval Base Developments for the Fleet**

CAPT. J. J. MANNING, *C.E.C., U.S.N., M. Am. Soc. C.E., Special Assistant to Chief of Bureau of Yards and Docks*, Washington, D.C.

4:00 **Construction for Defense by the Corps of Engineers**

COL. DAVID MCCOACH, JR., *C.E., U.S.A., M. Am. Soc. C.E., Executive Assistant, Office of Chief of Engineers*, Washington, D.C.

Dinner Dance and Reception

WEDNESDAY—October 15, 1941—Evening

7:00 Dinner Dance and Reception—Grand Ball Room, Palmer Pouse

Tickets are $3.50 for men; $2.50 for ladies; and $1.50 each for Juniors, members of Student Chapters, and their ladies.

Symposium on Civilian Protection in War Time

THURSDAY—October 16, 1941—Morning

Red Lacquer Room—Time, 9:00 a.m.

CHARLES H. STEVENS, *Vice-President, Am. Soc. C.E., Chairman;* ERNEST P. GOODRICH, *Director, Am. Soc. C.E., and Vice-Chairman, National Committee on Civilian Protection in War Time, Presiding*

This Symposium has been prepared and is presented by the Society's Committee on Civilian Protection in War Time. It is a part of the Society's contribution to give technical aid to the Government in this emergency.

What are the odds that American cities are safe from air and gas attacks? No one knows for sure.

Do we know what to do if or when they come? England has lived through a year of history's most savage aerial attack and has learned how to be reasonably safe and sane.

If we never need what we learn about how to protect our civilians, we will have lost nothing. If we never learn what we need, we have lost everything.

Eye-witness observers and visual evidence in the following program will help engineers to understand better their part in the civilian defense of the United States of America.

9:00 **Opening remarks**

ERNEST P. GOODRICH, *M. Am. Soc. C.E., Consulting Engineer,* New York, N.Y., *Chairman.*

9:05 **Keeping Transportation Moving**

FREDERICK C. HORNER, *Assistant to Chairman, General Motors Corporation,* New York, N.Y.; *Member of U.S. War Department Civil Defense Mission to England, January 1941; now Member, Central Motor Transport Committee, National Defense Advisory Commission,* Washington, D.C.

9:35 **Physical Aspects of Protecting Civilians from Bombing and from Gas Attacks**

COL. AUGUSTIN M. PRENTISS, *Chemical Officer, Sixth Corps Area,* Chicago, Ill.

Col. Prentiss is both a student and a teacher of his subject. His recent book, *Civil Air Defense,* is widely read.

10:05 **Lessons Learned in London**

WALTER D. BINGER, *M. Am. Soc. C.E., Commissioner of Borough Works, Borough of Manhattan,* New York, N.Y., *Chairman, National Technological Civil Protection Committee.*

Mr. Binger has just returned from England as Special Consultant to the Secretary of War.

10:35 **Moving Picture—The Bombing of Chunking on the Burma Road**

10:55 **Civil Engineers and the Office of Civilian Defense**

T. S. WALMSLEY, *Deputy Aide to Director, U.S. Office of Civilian Defense,* Washington, D.C., *and former Mayor of* New Orleans, La.

11:25 **Prompt Adjournment. Luncheon and Inspection Trip No. 1. Train leaves at 12:00 noon from LaSalle Street Station.**

Entertainment for the Ladies

WEDNESDAY—October 15, 1941

Luncheon, Fashion Show, Dinner Dance, Reception

Noon **Luncheon and Fashion Show, Marshall Field and Company**

At the close of the morning session, the ladies will assemble at Ladies' Headquarters, Parlor 11, third floor, Palmer House. Here they will be met by members of the Ladies' Reception Committee and conducted to Marshall Field and Company, where luncheon will be served promptly at 1:00 p.m. in the private English Dining Room.

During luncheon there will be a showing of the fall fashions. Following the fashion show there will be an opportunity to make a conducted tour of this famous department store.

Tickets for the luncheon, including the fashion show, are $1.00 each, and should be purchased at the Registration Desk, Society Headquarters, Palmer House.

7:00 **Dinner Dance and Reception, Grand Ball Room, Palmer House**

Tickets are $3.50 for men; $2.50 for ladies; and $1.50 each for Juniors, members of Student Chapters, and their ladies.

THURSDAY—October 16, 1941

Garden Tour, Luncheon, Get-Together, and Entertainment

11:00 **Trip to Lake Forest to View the Mill Road Gardens Chrysanthemum Show**

You will see acres of massed chrysanthemums in profuse variety of form and color—hardy strains developed under the Department of Botany, University of Chicago, and displayed in a matchless setting of autumn foliage. Surrounding an imposing French Provincial Manor House are 92 acres of beautifully landscaped grounds and gardens.

Luncheon will be served upon arrival at the gardens.

Busses will leave the Palmer House promptly at 11:00 a.m.

Total cost of trip, including luncheon, transportation, and tour of gardens and Manor House, is $1.25. Reservations for this trip close 5:00 p.m., Wednesday, October 15. Secure tickets at Registration Desk, Society Headquarters, Palmer House.

8:30 **Get-Together Smoker, Red Lacquer Room, Palmer House**

The ladies are invited to join the men for a Get-Together Smoker.

Tickets are $1.00 each for members, guests, and their ladies; and 50 cents each for Juniors, members of Student Chapters, and their ladies.

FRIDAY—October 17, 1941

Bus Excursion and Tour

All-Day Trip

Ladies are invited to join the members in an all-day excursion and tour of the city. Busses will leave the Palmer House at frequent intervals from 9:15 to 11:30 a.m.

For description of the tour, see announcement on excursions and inspection trips, Trip No. 2.

Tickets, including transportation, luncheon, and dinner, are $3.00 each.

Sessions of Technical Divisions

THURSDAY—October 16, 1941—Afternoon

WATERWAYS DIVISION

Room 17

L. C. Sabin, *Member, Executive Committee, Presiding*

3:00 **Introductory remarks**

L. C. Sabin, *M. Am. Soc. C.E., Vice-President, Lake Carriers' Association*, Cleveland, Ohio.

3:10 **The Calumet-Sag Waterway**

Rufus W. Putnam, *M. Am. Soc. C.E., President, Maritime Engineering Corporation*, Chicago, Ill.

Discussion by

3:40 Frederick E. Morrow, *M. Am. Soc. C.E., Chief Engineer, Chicago and Western Indiana Railroad and The Belt Railway of Chicago*, Chicago, Ill.

3:50 Horace P. Ramey, *M. Am. Soc. C.E., Assistant Chief Engineer, The Sanitary District of Chicago*, Chicago, Ill.

4:00 **General discussion**

4:10 **Economic and National Defense Value of the Illinois Waterway**

Clarence Raymond Andrew, *Assoc. M. Am. Soc. C.E., Principal Engineer, U.S. Engineer Office, 1st Chicago District*, Chicago, Ill.

4:40 **General discussion**

SOIL MECHANICS AND FOUNDATIONS DIVISION

Red Lacquer Room

Carlton S. Proctor, *Chairman, Executive Committee, Presiding*

3:00 **Introductory remarks**

Carlton S. Proctor, *M. Am. Soc. C.E., Consulting Engineer*, New York, N.Y.

3:10 **The Pendleton Levee Failure**

K. E. Fields, *Jun. Am. Soc. C.E., Captain, Corps of Engineers, U.S.A., Director, U.S. Waterways Experiment Station*, Vicksburg, Miss.

Discussion by

3:40 William H. Jervis, *Assoc. M. Am. Soc. C.E., Chief, Soils Section, Vicksburg Engineer District*, Vicksburg, Miss.

3:50 Ralph B. Peck, *Jun. Am. Soc. C.E., Assistant Subway Engineer, Department of Subways and Traction*, Chicago, Ill.

4:00 **The Present Status of the Technique of Determining the Shearing Strength of Soils: Report of Special Division Committee on Technique of Soil Tests**

B. K. Hough, Jr., *Assoc. M. Am. Soc. C.E., Senior Engineer, U.S. Engineer Department*, Binghamton, N.Y., *Chairman.*

4:30 **General discussion**

SANITARY ENGINEERING DIVISION

Crystal Room

Arthur D. Weston, *Chairman, Executive Committee, Presiding*

3:00 **Introductory remarks**

Arthur D. Weston, *M. Am. Soc. C.E., Chief Engineer, State Department of Public Health*, Boston, Mass.

3:10 **Sludge Drying Developments at Chicago**

Lloyd M. Johnson, *Engineer, Maintenance and Operation, The Sanitary District of Chicago*, Chicago, Ill.

Discussion by

3:40 Paul Hansen, *M. Am. Soc. C.E., Consulting Engineer*, Chicago, Ill.

3:50 Charles E. Gordon, *Engineer, Combustion Engineering Company*, Chicago, Ill.

4:00 **Trends in Organization and Financing of Sewage Treatment Projects**

Samuel A. Greeley, *M. Am. Soc. C.E., Consulting Engineer*, Chicago, Ill.

Discussion by

4:30 Milton P. Adams, *M. Am. Soc. C.E., Executive Secretary and Engineer, Michigan Stream Pollution Commission*, Lansing, Mich.

4:40 Hal F. Smith, *Senior Administrative Assistant, Board of Water Commissioners*, Detroit, Mich.

4:50 **Sewage and Garbage Disposal at Gary, Ind.**

William P. Cottingham, *M. Am Soc C E., City Engineer; President, The Sanitary District of Gary*, Gary, Ind.

Discussion by

5:20 Jerry Donohue, *M. Am. Soc. C.E., President, Jerry Donohue Engineering Company*, Sheboygan, Wis.

5:30 Linn H. Enslow, *Assoc. M. Am. Soc. C.E., Sanitary Engineer, The Chlorine Institute, Inc.; Editor, "Water Works and Sewerage,"* New York, N.Y.

HIGHWAY DIVISION

Room 14

R. W. Crum, *Chairman, Executive Committee, Presiding*

3:00 **Introductory remarks**

R. W. Crum, *M. Am. Soc. C.E., Director, Highway Research Board, National Research Council*, Washington, D.C.

3:10 **Army Airports and Runways**

William N. Carey, *M. Am. Soc. C.E., Colonel, Corps of Engineers, U.S.A., William N. Carey and Associates*, St. Paul, Minn.; *now Office of District Engineer*, Jacksonville, Fla.

Discussion opened by

3:40 Miles D. Catton, *Assoc. M. Am. Soc. C.E., Manager, Soil Cement Bureau, Portland Cement Association*, Chicago, Ill.

4:00 **General discussion**

4:10 **The Chicago Regional Highway Plan**

Robert Kingery, *General Manager, Chicago Regional Planning Association*, Chicago, Ill.

Discussion by

4:40 William E. O'Brien, *M. Am. Soc. C.E., Chairman, State Highway Commission*, Madison, Wis.

4:50 George A. Quinlan, *M. Am. Soc. C.E., Superintendent of Cook County Highways*, Chicago, Ill.

5:00 **General discussion**

Smoker

THURSDAY—October 16, 1941—Evening

8:30 **Get-Together Smoker—Red Lacquer Room, Palmer House**

Something new and different for all, including the ladies. Music, novel entertainment, and refreshments.

Tickets are $1.00 each for members, guests, and their ladies; and 50 cents each for Juniors, members of Student Chapters, and their ladies.

Sessions of Technical Divisions

FRIDAY—October 17, 1941—Morning

STRUCTURAL AND CONSTRUCTION DIVISIONS

Room 14

SHORTRIDGE HARDESTY, *M. Am. Soc. C.E., Consulting Engineer, New York, N.Y.; Chairman, Executive Committee, Structural Division, Presiding*

9:30 **Introductory remarks**

LAZARUS WHITE, *M. Am. Soc. C.E., President, Spencer, White and Prentis, Inc.,* New York, N.Y.; *Member, Construction Division Committee on Construction Engineering Education.*

9:40 **Coordination of Design and Construction Methods on the Chicago Subway**

PETER F. GIRARD, JR., *M. Am. Soc. C.E., Engineer of Subway Design, Department of Subways and Superhighways,* Chicago, Ill.

Discussion by

10:10 FRANK A. RANDALL, *M. Am. Soc. C.E., Consulting Structural Engineer,* Chicago, Ill.

10:20 R. F. KELKER, JR., *M. Am. Soc. C.E., Consulting Engineer, City of Chicago,* Chicago, Ill.

10:40 **Results of Earth Pressure Measurements on the Chicago Subway**

RALPH B. PECK, *Jun. Am. Soc. C.E., Assistant Subway Engineer, Department of Subways and Traction,* Chicago, Ill.

Discussion by

11:10 RALPH H. BURKE, *M. Am. Soc. C.E., Chief Engineer, Chicago Park District, Department of Subways and Superhighways,* Chicago, Ill.

11:20 W. S. HOUSEL, *M. Am. Soc. C.E., Associate Professor of Civil Engineering, University of Michigan; Research Consultant, State Highway Department,* Ann Arbor, Mich.

SOIL MECHANICS AND FOUNDATIONS DIVISION

Red Lacquer Room

CARLTON S. PROCTOR, *Chairman, Executive Committee, Presiding*

9:30 **Correlation of Earth Pressure Measurements and Shearing Resistance Tests in Plastic Clay**

W. S. HOUSEL, *M. Am. Soc. C.E., Associate Professor of Civil Engineering, University of Michigan; Research Consultant, State Highway Department,* Ann Arbor, Mich.

Discussion opened by

10:00 L. G. LENHARDT, *M. Am. Soc. C.E., General Manager and Chief Engineer, Department of Water Supply,* Detroit, Mich.

10:10 **General discussion**

10:20 **Application of Soil Mechanics to the Construction Problems on the Chicago Subway**

KARL TERZAGHI, *M. Am. Soc. C.E., Lecturer, Harvard University,* Cambridge, Mass.

10:50 **General discussion**

SANITARY ENGINEERING DIVISION

Crystal Room

ARTHUR D. WESTON, *Chairman, Executive Committee, Presiding*

9:30 **Development of Water Filtration at Chicago**

LORAN D. GAYTON, *M. Am. Soc. C.E., City Engineer, Department of Public Works,* Chicago, Ill.

Discussion opened by

10:00 JOSEPH P. SCHWADA, *Assoc. M. Am. Soc. C.E., City Engineer,* Milwaukee, Wis.

10:20 **Effect of Metering on Water Filtration Costs at Chicago**

ARTHUR E. GORMAN, *M. Am. Soc. C.E., Engineer of Water Purification, City of Chicago,* Chicago, Ill.

Discussion by

10:50 FRED G. GORDON, *M. Am. Soc. C.E., Consulting Engineer,* Chicago, Ill.

11:00 J. B. EDDY, *Engineer, Water Pipe Extension, City of Chicago,* Chicago, Ill.

11:10 **Ozone Treatment for Taste and Odor Control**

ARTHUR W. CONSOER, *M. Am. Soc. C.E., President and General Manager, Consoer, Townsend and Quinlan,* Chicago, Ill.

Discussion by

11:40 B. A. POOLE, *Assoc. M. Am. Soc. C.E., State Sanitary Engineer, State Board of Health,* Indianapolis, Ind.

11:50 JOHN R. BAYLIS, *Assoc. M. Am. Soc. C.E., Physical Chemist, Bureau of Engineering, Department of Public Works, City of Chicago,* Chicago, Ill.

CITY PLANNING DIVISION

Room 17

HARLAND BARTHOLOMEW, *Chairman, Executive Committee, Presiding*

9:30 **Introductory remarks**

HARLAND BARTHOLOMEW, *M. Am. Soc. C.E., Harland Bartholomew and Associates,* St. Louis, Mo.

9:40 **Residential Land Use Trends in Chicago as Revealed by the 1939–1940 Land Use Survey**

HUGH E. YOUNG, *M. Am. Soc. C.E., Chief Engineer, Chicago Plan Commission,* Chicago, Ill.

Discussion by

10:10 THEODORE T. MCCROSKY, *M. Am. Soc. C.E., Executive Director, Chicago Plan Commission,* Chicago, Ill.

10:20 JOHN E. MOTE, *Chief Market Analyst, Federal Housing Authority,* Chicago, Ill.

10:40 **Central Business District Trends in Chicago**

LEO J. SHERIDAN, *L. J. Sheridan and Company,* Chicago, Ill.

Discussion by

11:10 HOMER HOYT, *Director of Research, Chicago Plan Commission,* Chicago, Ill.

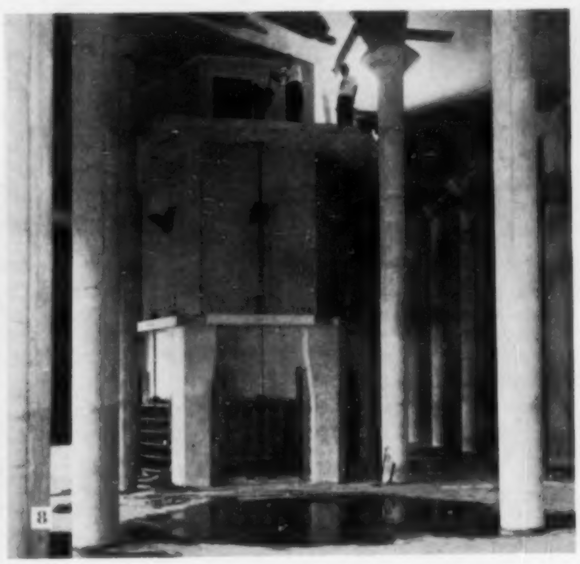
11:20 THEODORE T. MCCROSKY, *M. Am. Soc. C.E., Executive Director, Chicago Plan Commission,* Chicago, Ill.

Titles for Views on Facing Page

(1) Southwest Sewage Treatment Plant, Sanitary District of Chicago. (2) Modern Transportation Equipment at One of Chicago's Noted Terminals. (3) A Modern Streamline Train Leaving Chicago. (4 & 5) Downtown Bridges Looking West from Wabash Avenue. Note State Street Bridge Cofferdams. (6) Locks Controlling the Flow of Water from Lake Michigan. (7) Subway Construction. (8 & 9) South District Filtration Plant Sluice Gate and Filtration Plant Tunnels. (10) Completed Subway Tubes and Crossover. (11) One of Chicago's Noted Industries—Meat Packing. Stockyards in Foreground. (12 & 13) Water Intake Cribs in Lake Michigan. (14) Buckingham Fountain in Grant Park. (15) Unloading a Cargo of Iron Ore.

Points of Engineering Interest in Chicago

(See Titles on Page 618)



Excursions and Inspection Trips

Chicago is full of engineering interest, and has had a most interesting engineering history. Here the skyscraper was born; movable bridges were advanced by the building of more than 60 structures now operated by the Bureau of Engineering; and sanitary engineering received world-wide attention with the building of the Chicago Drainage Canal and reversal of the Chicago River.

Chicago is proud of its parks, water works, sewage plants, lake front, and the Chicago River locks, industrial plants, stockyards, museums, Art Institute, new subway structure, and many other engineering and cultural features.

Six inspection trips and tours have been organized, as outlined below, but if you would like to see anything else, please apply to the Information Desk and if possible suitable arrangements will be made.

Please make reservations on Wednesday, October 15, for the inspection trips in order that the Committee may make proper arrangements for transportation and guides.

THURSDAY—October 16, 1941

Trip No. 1

Inspection and complimentary luncheon at the Chicago Bridge and Iron Company plant as guests of the Company, George T. Horton, M. Am. Soc. C.E., President. Lunch will be served in the new Employees Recreational Building, a most unusual steel dome structure, 80 ft in diameter. Inspection will include this structure and the company's fabricating plant. A special train on the Rock Island Railroad will leave the LaSalle Street Station at 12:00 noon, returning in time for the afternoon Technical Division sessions, which will begin at 3:00 p.m. Transportation and luncheon, courtesy of the Chicago Bridge and Iron Company.

FRIDAY—October 17, 1941

Trip No. 2

An all-day excursion, including luncheon and dinner, has been arranged for all members and ladies. A flexible starting schedule will permit joining the excursion after the Friday morning sessions.

Busses will leave the Palmer House at frequent intervals from 9:15 to 11:30 a.m., departing as needed until the morning sessions end. Early busses will stop at the South Side Water Filtration Plant for an inspection of this interesting project (see details in Trip No. 3), then will continue to the Museum of Science and Industry, in Jackson Park, for an inspection of special exhibits, including a coal mine.

Later busses will proceed direct to the Museum, but will afford time for the inspection of exhibits. The last busses will arrive at the Museum in time for luncheon only.

Luncheon will be served at the Museum, after which the busses will proceed northward along the lake shore and through the suburbs to the Great Lakes Naval Training Station. The tour en route will pass many interesting places, including numerous grade separations, park structures, Soldiers Field, Field Museum, Planetarium, Aquarium, Outer Drive Bridge, Chicago River Locks, Navy Pier yacht harbors, and beaches.

There will be a 30-minute stop at the new home of the Northwestern Technological Institute at Evanston, now nearing completion. Scheduled for opening this fall, a construction fire last December seriously delayed progress on this beautiful $5,000,000 structure, but the damage has all been repaired, parts of the building are now complete, and the whole will be finished early next year. The Civil Engineering Department is one of the first sections to be completed.

Leaving Evanston the tour will pass through the north suburbs and Fort Sheridan. At Great Lakes Naval Training Station, a special review of Naval Cadets is scheduled for 4:00 p.m., after which evening mess will be shared with the sailors.

After dinner the party will return to Fort Sheridan to witness anti-aircraft machine gun firing under searchlights.

The return trip to the Palmer House will be made after dark, when the illumination of the city may be seen from the Lake Front Drive.

Tickets, including transportation, luncheon, and dinner, are $3.00 each. Reservations close on Wednesday, October 15.

SATURDAY—October 18, 1941

Four separate inspection trips are scheduled leaving the Palmer House at 9:00 a.m.

Trip No. 3—South Side Water Filtration Plant 79th Street and the Lake

Chicago is building the largest water filtration plant in the world, to cost about $63,000,000. It is of the rapid sand filter type, will treat 320 mgd with a maximum hourly peak at the rate of 450 mgd, designed to serve that part of the city south of 39th Street, with present population 1,200,000 and anticipated 1960 population 1 400 000. You will see the new breakwater that protects the plant, the cofferdam fill surrounding the plant, foundation and concrete tank structures now complete, and the backfilling that is under way. Large areas of the nearby lake sections have been filled in for parks. Return at 12:00 noon.

Tickets are $1.00 each.

Trip No. 4—Southwest Side Sewage Treatment Plant, on the Drainage Canal

The second half of this huge activated sludge plant, which, when completed, will be the largest in the world, is now under construction. You will see many interesting steps in the construction of a large sewage plant, and will also have an opportunity of seeing the first half of the plant, completed several years ago, in operation. This plant will virtually complete the city's program to treat all of its sewage and thus comply with the Supreme Court order for reduction of diversion of Lake Michigan water into the Drainage Canal. Return at 12:00 noon.

Tickets are $1.00 each.

Trip No. 5—Housing Projects

This trip will cover three large housing projects, all of different types: Julia Lathrop Housing Project, northwest side; Jane Addams Housing Project, near west side; and Ida B. Wells Housing Project, south side in the colored district. These projects were built at different times, and the trip will afford opportunity of comparing the three types built to meet varying conditions. Return at 12:00 noon.

Tickets are $1.00 each.

Trip No. 6—Subway

Chicago is building its first subway, and the initial system, totaling 8 miles of double-track tunnels, is now nearing completion. Chicago engineers may not know as yet who will operate the subways, or just when trains will be rolling, but they do know they have a fine underground structure that is the nucleus of a great transportation system to come some day. The tunnels on the initial system are complete; connections to the elevated lines and station construction are now under way. Return at 10:30 a.m.

There is no charge for this trip, as the Palmer House State Street entrance is on the subway line.

SHIELD MINING ON SUBWAY IN CHICAGO LOOP

Local Sections Conference

TUESDAY—October 14, 1941

Crystal Room, Palmer House

J. T. L. McNew, *Chairman, Society Committee on Local Sections, Presiding*

The third Regional Local Sections Conference for 1941 will include twenty-seven Local Sections of the south and central areas of the country. All interested members of the Society are invited to attend and participate in the discussions. The official representatives will discuss generally the following two main questions, and in detail the specific subjects listed below.

How Can Local Sections Be of Greatest Assistance in the National Defense Construction Program?

How Can Local Sections Be of Greatest Benefit to the Profession?

Morning, 9:30–12:00 a.m.

9:30 (*a*) **Address of Welcome**
Robert I. Randolph, *President, Illinois Section.*

(*b*) **How Can Local Sections Be of Greatest Assistance in the National Defense Construction Program?**

(*c*) **Is the Supply of Engineers Adequate for Defense Construction?**

(*d*) **Training Civil Engineers for National Defense Industry**

(*e*) **Effect of Unionization on the Civil Engineering Profession**

(*f*) **Civil Engineers' Part in Post-War Emergency Planning for Public Works Construction**

12:00 **Adjournment for Luncheon with members of the Board of Direction in Private Dining Room, Palmer House**
Tickets are $1.45 each.

Afternoon, 2:00–4:30 p.m.

2:00 (*g*) **Society Aid in the National Defense Program**
Frederick H. Fowler, *President, Am. Soc. C.E.*

(*h*) **Society Functions Performed by Local Sections**
George T. Seabury, *Secretary, Am. Soc. C.E.*

(*i*) **Civil Engineers and the Wages and Hours Act**

(*j*) **How Do Local Selective Service Draft Boards Defer Civil Engineers?**

(*k*) **Relation of Local Sections to Local Government**

(*l*) **The Juniors' Part in Local Section Activities**

(*m*) **1940 Section Activities**

(*n*) **The Part of Local Sections in the E.C.P.D. Program of High School Student Guidance**

Student Chapter Conference

WEDNESDAY—October 15, 1941

Crystal Room, Palmer House

Dean L. E. Grinter, *Chairman, Illinois Section Committee on Student Chapter Conference, Chairman*

John H. Porter, *Chairman, Society Committee on Student Chapters, Presiding*

Clifford Krabbenhoft, *President, Junior Section of Illinois Section, Honorary Chairman*

9:00 **Registration at Society Headquarters, Foyer, Palmer House**

10:00 **Opening Session, Crystal Room**
Addresses:
Henry T. Heald, *M. Am. Soc. C.E., President, Illinois Institute of Technology,* Chicago, Ill.
Franklyn Snyder, *President, Northwestern University,* Evanston, Ill.
Announcements

10:30 **Student Papers, Prize Essay Contest**

12:30 **Informal luncheon groups**

2:00 **Symposium on National Defense Construction, Red Lacquer Room**
Students will join members.

7:00 **Society Dinner-Dance and Reception, Grand Ball Room**
Special tickets for members of Student Chapters and their dates, $1.50 each.

THURSDAY—October 16, 1941

Crystal Room, Palmer House

Presiding Officer to Be Selected by the Conference

9:00 **Student Papers, Prize Essay Contest** (Continued)

12:15 **Student Luncheon and Award of Essay Contest Prizes in LaSalle Hotel, Madison Avenue at LaSalle Street**
Toastmaster: Loran D. Gayton, *M. Am. Soc. C.E., City Engineer, Department of Public Works,* Chicago, Ill.
Complimentary to members of Student Chapters.

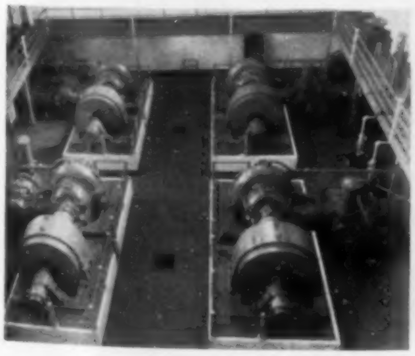
2:00 **Special Student Inspection Trip to Chicago Subway**

8:30 **Society Get-Together Smoker and Entertainment, Red Lacquer Room**
Special tickets for members of Student Chapters and their dates, 50 cents each.

FRIDAY—October 17, 1941

9:30 **Attend Society Technical Division Sessions**

11:30 **All-Day Excursion and Tour of Chicago, Trip No. 2**
(See program for description.)
Tickets, including transportation, luncheon and dinner, are $3.00 each.



Cermak Pumping Station
Each Unit Rated at 34,750 gpm

Michigan Boulevard
Chicago's Famous Front Door

South District Filtration Plant
West Substructure

Hotel Accommodations and Announcements

Hotel Rates

Hotels	All with Private Bath		
	Single	Double	Twin Bed
Palmer House, State St. between Monroe and Wabash	$3.85 up	$5.50 up	$6.60 up
Stevens, Michigan Ave. at 7th St	3.25 up	4.75 up	6.00 up
La Salle, Madison Ave. at La Salle St	2.75 up	4.40 up	5.50 up
Congress, Michigan Ave. at Congress St	3.00 up	4.50 up	.....
Chicagoan, 67 West Madison St	2.50 up	4.00 up	.....
Harrison, Harrison St., west of Michigan Ave	2.50 up	3.50 up	4.00 up
Fort Dearborn,* 117 West Van Buren St	2.00	.....	3.50
Atlantic,† Clark near Jackson	2.25 up	3.25 up	4.50 up

* Single, without bath, $1.50; extra guest, $1.00.
† 3 persons in room, $4.50 up; 4 persons in room, $6.00 up.

The Palmer House is the Society Headquarters for the Fall Meeting.

To be certain of hotel accommodations, members are urged to make reservations directly with the hotel of their choice at least one week ahead of the Meeting date.

Everyone attending the Fall Meeting is requested to register at Society Headquarters, Palmer House, immediately upon arrival. Tickets and badges will be obtained at time of registration.

Order All Tickets in Advance

By ordering tickets in advance members will be saved delay by having tickets and badges awaiting them upon arrival at Headquarters, and advance ticket reservations will greatly aid the Committees in making final arrangements for the various functions. Tickets for the joint luncheon with the Chicago Association of Commerce on Wednesday noon, October 15, 1941, **must be ordered in advance.**

Send your ticket order to George B. Massey, *Chairman, Hotel and Registration Committee, Palmer House,* Chicago, Ill. Please make checks payable to George B. Massey. See page 33 of Advertising Section for Ticket Order Form.

Information

An Information Desk will be provided at Society Headquarters in the Palmer House to assist visiting members and to furnish information about the Meeting and the city. A card file of those in attendance, with Chicago addresses, will be maintained at the Registration Desk.

Every effort will be made to deliver messages and telegrams promptly. Mail for members received at Society Headquarters will be delivered to hotel address, if known; otherwise it will be held at Information Desk. Letters undelivered at close of meeting will be forwarded to latest mailing address.

The Hotel and Registration Committee will make air, railroad, and Pullman reservations, and will have information available on automobile, air, bus, train and boat travel from the city. Request for travel reservations and information should be made at Transportation Desk at Society Headquarters.

Golf

Guest cards will be secured for members wishing to play golf provided they signify their desires at the Information Desk.

Fun in the Evenings

Top-notch social events have been arranged for both evenings of the technical sessions, where technical-weary delegates may cast aside their woes and worries, and relax. Dinner Dance and Reception, Wednesday evening; Get-Together Smoker, Thursday evening. See program for details.

Entertainment for the Ladies

Attention is directed to the entertainment provided for the ladies. However, they may participate with the members in any other features of the program in which they are interested, except Trip 1.

Local Sections Conference, Tuesday, October 14, 1941

A conference of representatives of Local Sections will meet at 9:30 a.m., Tuesday, October 14, 1941, at the Palmer House. The program will schedule topics of professional rather than technical interest, in which all representatives are expected to participate. All members of the Society are welcome to attend. For further details, see program.

Student Conference, Wednesday and Thursday, October 15 and 16, 1941

Members of Student Chapters are invited to participate in all events of the Fall Meeting. Attention is called to the program of the Student Chapter Conference on Wednesday and Thursday, October 15 and 16, 1941, the complimentary luncheon to students on Thursday noon at the La Salle Hotel, at which the prize awards will be made, and the special subway inspection trip on Thursday afternoon. For complete details, see program.

Individual and Group Inspection Trips

For information on individual and group inspection trips to industrial plants, engineering projects, museums, art collections, and other points of cultural and historical interest, please apply at Information Desk, Society Headquarters, Palmer House.

Looking Southeast Over Grant Park
Adler Planetarium, Shedd Aquarium, Field Museum, Park Administration Building and Soldiers Field in the Background

Adler Planetarium
An Outstanding Institution of Its Type, Built Only a Few Years Ago on Chicago's Lake Front, and Already Known to Millions

LOCAL COMMITTEES ON ARRANGEMENTS

Advisory Committee

Hon. Edward J. Kelly, *Honorary Chairman*
Charles B. Burdick, *Vice-President, Zone III, Chairman*
George B. Massey, *Director, District 8, Vice-Chairman*
Robert I. Randolph, *President, Illinois Section*
Julian W. Powers, *President, Arizona Section*
Randolph P. Hoelscher, *President, Central Illinois Section*
C. Vernon Youngquist, *President, Central Ohio Section*
Frederick F. McMinn, *President, Cincinnati Section*
George W. Hamlin, *President, Cleveland Section*
Ralph L. Parshall, *President, Colorado Section*
John F. Hale, *President, Dayton Section*
Roland C. Buck, *President, Duluth Section*
Laurence E. Martin, *President, Indiana Section*
Mark B. Morris, *President, Iowa Section*
Frank M. Cortelyou, *President, Kansas City (Mo.) Section*
Murray A. Wilson, *President, Kansas Section*
William O. Snyder, *President, Kentucky Section*
Edward L. Eriksen, *President, Michigan Section*
W. Scott Johnson, *President, Mid-Missouri Section*
Frank V. Ragsdale, *President, Mid-South Section*
Roy M. Green, *President, Nebraska Section*
William J. Titus, *President, Northwestern Section*
Curtis H. Guernsey, *President, Oklahoma Section*
Frederick C. Woermann, *President, St. Louis Section*
Roy A. Nyquist, *President, Toledo Section*
Horace P. Warren, *President, Tri-City Section*
Clarence A. Willson, *President, Wisconsin Section*
Alex J. McGaw, *President, Wyoming Section*

Executive Committee

Robert I. Randolph, *Chairman*
Craig P. Hazelet, *Secretary*
J. de N. Macomb, *Past-President, Illinois Section, and Chairman Entertainment Committee*
J. F. Seifried, *Chairman, Finance Committee*
George B. Massey, *Chairman, Hotel and Registration Committee*
H. W. Richardson, *Chairman, Publicity Committee*
Hugh E. Young, *Chairman, Excursion Committee*
L. R. Howson, *Chairman, Program Committee*
George A. Maney, *Chairman, Local Sections Conference*
L. E. Grinter, *Chairman, Student Chapter Conference*
T. L. Condron, *Chairman, Past Officers and Directors Reunion*
Clifford R. Krabbenhoft, *President, Junior Section of Illinois Section*
Mrs. Henry T. Heald, *Chairman, Ladies' Reception Committee*

Finance Committee

J. F. Seifried, *Chairman*
Edward C. Cardwell — George W. Hand
George T. Donoghue — Philip Harrington
F. G. Gordon — C. W. Haupt
George T. Horton

Hotel and Registration Committee

George B. Massey, *Chairman*
Robert T. Allen — Paul Hansen
W. G. Arn — L. P. Keith
I. F. Stern

Publicity Committee

H. W. Richardson, *Chairman*
Henry A. Beekman — E. T. Howson
Loran D. Gayton — Clifford R. Krabbenhoft
Kenneth E. Welton

Entertainment Committee

J. de N. Macomb, *Chairman*
Edward J. Fucik — Lenox R. Lohr
Loran D. Gayton — Theodore T. McCrosky
Mrs. Henry T. Heald — P. A. Peller
Hal P. Kibbey — C. Earl Webb

Rosenwald Museum of Science and Industry

Excursion Committee

Hugh E. Young, *Chairman*
Donald N. Becker — Joseph A. Leadabrand
Edward P. Cranley — Lenox R. Lohr
Robert A. Jackson — A. J. Schafmayer
William H. Trinkaus

Program Committee

L. R. Howson, *Chairman*
C. R. Andrew — Walter S. Lacher
Ralph H. Burke — Theodore T. McCrosky
Edward C. Cardwell — Donald G. Marshall
F. T. Darrow — Henry Penn
W. W. DeBerard — H. P. Ramey
Loran D. Gayton — Frank A. Randall
Henry T. Heald — Albert Smith
William C. Hill — Frank K. Veasman
John W. Woermann

Local Sections Conference

George A. Maney, *Chairman*

Student Chapter Conference

L. E. Grinter, *Chairman*
C. R. Ege — Lawrence H. Lyle
Leonard M. Gordon — E. C. Shuman
L. T. Tyly

Past Officers and Directors Reunion

T. L. Condron, *Chairman*
F. T. Darrow — Albert F. Reichmann

Junior Section of Illinois Section

Clifford R. Krabbenhoft, *President*

Ladies' Reception Committee

Mrs. Edward J. Kelly, *Honorary Chairman*
Mrs. Henry T. Heald, *Chairman*
Mrs. Robert I. Randolph — Mrs. Hal P. Kibbey
Mrs. J. de N. Macomb — Mrs. Clifford R. Krabbenhoft
Mrs. Edward C. Cardwell — Mrs. Lenox R. Lohr
Mrs. T. L. Condron — Mrs. Lawrence H. Lyle
Mrs. F. T. Darrow — Mrs. Theodore T. McCrosky
Mrs. W. W. DeBerard — Mrs. George A. Maney
Mrs. Edward J. Fucik — Mrs. Donald G. Marshall
Mrs. Loran D. Gayton — Mrs. Langdon Pearse
Mrs. Samuel A. Greeley — Mrs. H. P. Ramey
Mrs. L. E. Grinter — Mrs. Albert F. Reichmann
Mrs. L. W. Hall — Mrs. H. W. Richardson
Mrs. Craig P. Hazelet — Mrs. J. F. Seifried
Mrs. L. R. Howson — Mrs. C. Earl Webb
Mrs. Hugh E. Young

The program as a whole has been prepared under the direction of the Fall Meeting Committee, composed of Charles B. Burdick, *Vice-President, Am. Soc. C.E., Chairman*, and Clarence M. Blair, Robert B. Brooks, William N. Carey, John W. Cowper, E. E. Howard, George B. Massey, and Ralph B. Wiley, *Directors, Am. Soc. C.E.*

Please call on the Local Committee on Arrangements or on the Secretary's office for any service desired.

SOCIETY AFFAIRS

Official and Semi-Official

Engineering Examiners Meet in New York, October 27–30

Representatives of 40 state boards for the registration of engineers are to meet in New York October 27–30 for the Twenty-Second Annual Meeting of the National Council of State Boards of Engineering Examiners. This is expected to be one of the most important meetings in the history of the Council as it is to be held in connection with the annual meeting of the Engineers Council for Professional Development. Participating in the discussions will be representatives of the Dominion Council of Professional Engineers of Canada and representatives of the national engineering societies of this country.

Questions of growing importance, such as reciprocal registration between the states and national registration, are to be discussed at the business meetings. The effect of registration on the engineering profession is to be considered at a luncheon meeting held at the Engineers Club in which members of the Engineers Council for Professional Development and the headquarters staffs of the national engineering societies will participate.

Defense questions are not to be overlooked at the meeting. Mayor LaGuardia of New York, U.S. Director of Civilian Defense, is to be the principal speaker at the annual banquet.

Forty-four states now have adopted engineering registration. This leaves only four without such laws, one of which is expected to fall in line in the near future. Recent additions are Delaware and Missouri. In Illinois, where a structural engineer's license has been in effect for many years, a law covering all professional engineers will go into effect in 1943.

Great Engineers Whose Life Stories Have Appeared in "Civil Engineering"

Thomas Telford—November 1936, page 727, and December 1936, page 796

Mortimer E. Cooley—February 1938, page 90

Robert Ridgway—September 1938, page 607

George E. Pegram—January 1939, page 24, February 1939, page 100, March 1939, page 176, and April 1939, page 243

Otis E. Hovey—August 1939, page 483

William Mulholland—February 1941, page 105, and March 1941, page 161

Theodore Dehone Judah—This issue, page 586

Beginning the Twelfth Year

With this issue, Civil Engineering catches up with another anniversary. Eleven years ago, in October 1930, the publication was started. The present number therefore inaugurates its twelfth year. Because the first calendar year was so short, Volume 1 included all of 1931 as well as the three months in 1930. Accordingly, Volume 12 of Civil Engineering will begin in January 1942.

Many events have taken place in this period. Among other things, a great depression has stricken America, only to be followed by an epochal world crisis. Had such conditions been foreseen, it is a question whether the launching of the publication would have seemed justifiable.

But events have proved the issue. The Society is larger and more active than ever before, and its publications are yearly taking new strength for worthwhile tasks to serve the profession.

A brief moment for review of the eleven years that have gone provides a spur toward further accomplishment in the years to come. Civil Engineering restates its ambition to reflect for the benefit of the Society and the profession the more important advances as they continuously unfold.

To Safeguard Essential Municipal Services

The Secretary of War recently issued a caution that might well be heeded by those engineers engaged in the management and operation of power plants, water supplies, sewerage systems, or the other facilities essential to the welfare and convenience of the public. His caution was to the effect that while responsible persons, properly representative of governmental agencies, may with propriety seek vital information, deemed confidential, they should be refused such information until they shall have adequately demonstrated the authority under which they operate. The Secretary, in addition to his words of caution, gave instructions that all proper officials making intimate inquiries must be supplied with complete credentials.

These phases of a problem that is now growing in importance are brought to the attention of members at the suggestion of the National Technological Civil Protection Committee.

E.C.P.D. Announces Annual Meeting in New York City on October 30

The Annual Meeting of the Engineers Council for Professional Development, although last year held in Pittsburgh, will this fall again revert to its customary meeting place in New York City. The date selected, Thursday, October 30, follows immediately after the yearly sessions of the National Council of State Boards of Engineering Examiners, which are also scheduled for New York on the three preceding days, October 27–29.

Although these two organizations are not meeting jointly, nevertheless it is expected that there will be a generous overlapping of attendance, and the arrangements have been designed to further this worthwhile purpose. One special focus for joint attendance is the annual banquet of the National Council of State Boards of Engineering Examiners on Tuesday evening. Similarly, the annual dinner of E.C.P.D., to be held on Thursday evening, is expected to attract many of those who are delegates to the earlier convention.

Three separate sessions of the E.C.P.D. meeting are in prospect for Thursday. In the forenoon, reports from various committees will be received and discussed. Following lunch there will be an executive session, devoted to accrediting and similar confidential features of the work. At dinner the program will be attuned to the special professional problems incident to the present national emergency.

The fine work being done by E.C.P.D. should be a matter of pride and interest to all members of the Society. Those interested are welcome to attend the public meetings, including the dinner. Sessions will be held at the Engineering Societies Building, with dinner at the adjoining Engineers Club. The president of E.C.P.D. is Robert E. Doherty, president of the Carnegie Institute of Technology, and for 1940–1941, George T. Seabury is secretary.

FALL MEETING of the Society, in Chicago, Ill., October 15–18, with Headquarters at the Palmer House

Army Claims Allen P. Richmond, Jr.

Another of the Headquarters staff has been called to emergency military duty—Lt. Col. A. P. Richmond, Jr., M. Am. Soc. C.E., who reported in Washington, D.C., on September 8, 1941.

He has been with the Society since 1929, following extensive service in the tropics and as assistant professor of civil engineering at the Thayer School of Civil Engineering, Dartmouth College.

Allen P. Richmond, Jr., M. Am. Soc. C.E. Lieutenant Colonel, Field Artillery

As Assistant to the Secretary, he has been assigned a variety of Society duties, principally in connection with committee work, handling correspondence and the many administrative details connected with the Committees on Salaries, Registration, Engineering Education, and similar work. In addition, much of his time has been devoted to the activities of the Student Chapters and to the Board of Direction's Committee on Membership Qualifications. Over the past two years he has conducted three extensive surveys of engineering salaries in connection with State Highway Departments in Arizona, Nevada, and Nebraska, and prepared the Society's Manual on Engineering Positions and Salaries, soon to be issued to the membership.

Similarly in military affairs he has been active for many years, beginning at the Plattsburgh Training Camp in 1916. He was a first lieutenant in the first World War and subsequently returned to the Field Artillery Reserve, to the work of which he has given assiduous attention over the succeeding years. In August he received his promotion to lieutenant colonel.

Through his duties at Society meetings and other official activities, Colonel Richmond has become well known throughout the Society. His many friends at headquarters and elsewhere wish him well in his new assignment, for which he is so well fitted by temperament, character, and training. His military orders have assigned him to active duty in the Division of Reemployment, Selective Service System, Washington, D.C.

Engineering Division of National Research Council Has New Headquarters in Washington

Already the center of war effort, Washington has an additional activity of special interest to engineers. Headquarters of the Division of Engineering and Industrial Research of the National Research Council have been transferred there from New York.

The organization originated in 1917 under the National Academy of Sciences. It was started to call to the aid of the Government, for the study of the problems of war, any scientist or technologist who might presumably give effective service in the solution of such problems. It comprised divisions of engineering, physics, medicine, and similar sciences, including a military division.

With the close of the World War, demands for the study of war problems became less pressing and the activities of the Division of Engineering and Industrial Research turned in greater degree along lines of industry and industrial technology. With the purpose of facilitating contact with engineers and industry, the office of the Division was set up in New York in the Engineering Societies Building, in convenient contact with many centers of direction of great industrial activities.

In view of the supreme effort that we are now called on to make in connection with war preparedness and war aid to other nations, it has seemed wise to transfer the office of the Division to Washington, thus greatly facilitating physical contact with the directional elements of the defense program now centered in the national capital. As of July 1, 1941, the office of the Division was assigned to the building of the National Academy of Sciences. In the meantime the office in New York is being continued for such period as may be necessary for winding up certain activities that can be more conveniently handled from that center.

The function of the Division, as derived from its relation to the National Academy and as seen by its executive staff, is to stand as a clearing house of information between the war effort now centered in the Departments of War and the Navy and in certain recently created organizations, and the vast reservoir of potential information and service formed by the engineering and industrial groups of the United States, and as represented primarily by the national engineering societies whose headquarters are for the most part in New York City. It is also active in organizing special committees for the study of matters related to the war effort, and in finding qualified experts for the study of special phases of these problems. Its officers and members also have membership on various committees and organizations which are related in one way or another to the defense program.

One of the important activities in the field of civil engineering is the work of the Highway Research Board. Its accomplishments and contributions to the progress of highway engineering are well known and widely recognized.

Under the present set-up of the Division of Engineering and Industrial Research, Dr. W. F. Durand, past-president of the American Society of Mechanical Engineers, is acting as chairman, and Dr. W. H. Kenerson, recently retired as head of the engineering work at Brown University and formerly a vice-president of the American Society of Mechanical Engineers, is acting as executive secretary. They are assisted by the necessary clerical and secretarial force. A more comprehensive account of the work of the Division appears in the current issue of *Mechanical Engineering*.

A Milestone in Civil Engineering—Volume 106 of "Transactions"

Somewhat smaller than last year (since it contains no final reports) but of good size nevertheless, Volume 106 of Transactions is now off the press. About half of the total edition will be bound in paper and will be mailed as Part 2 of the October Proceedings—free to members. The remainder will be delivered within a relatively short time bound in cloth and half-morocco as specially ordered by that large group who regard Transactions as the cumulative index of all that makes for progress in civil engineering—a milestone in the development of the profession.

Those who tend to sample rather than dip deeply into the reservoir of new thinking in civil engineering should gain courage to read from the fact that only about one-third of Volume 106 has to do with technical design problems. Another third concerns the flow of water in its various aspects. The remaining third, for the most part, concerns broad planning problems such as those required in shaping the essential features of a regional district, a sewage disposal project, or a railway terminal.

A common misconception concerning Transactions is that it is merely a recompilation of out-of-date material published previously in Proceedings. It is true that, of its 1,840 pages, over 1,500 were published in Proceedings. But these have been recompiled, and discussion follows each paper directly, together with the author's final closure.

The remainder, however, comprises about 300 pages of biographical material that appears for the first time. These professional memoirs of deceased members contain the ingredients for hours of inspirational reading. Headed by the matchless record of Robert Ridgway, Past-President and Hon. M. Am. Soc. C.E.—builder of subways—the memoirs include the life stories of 101 civil engineers—such men as C. H. Birdseye and William Bowie, Government surveying officials; Henry Goldmark, designer at the Panama Canal; L. F. Loree, railway president; Ralph Modjeski, bridge builder; George W. Tillson, highway official, author, and Society officer; Samuel M. Vauclain, locomotive manufacturer; and many others.

Taken all in all, the 1941 Transactions is a notable volume that any member can prize. It adds further luster to the fine record set by its predecessors, bringing up to date a private library for each member that is without peer in the field of civil engineering.

Speakers Club Benefits Sacramento Members

THE Professional Objectives Committee of the Sacramento Section believe that the engineering profession is doing innumerable things of great interest today that the public is eager to hear about. They also believe that with a small amount of training the engineer can learn to tell his story in a most interesting and constructive manner.

With this thought in mind, the Professional Objectives Committee organized a Speakers Club for the sole use of Society members in the Sacramento area. The purpose of the club is to develop good speakers for the dissemination of engineering knowledge to the general public, and to give Society members an opportunity to develop in the art of public speaking. Forty-seven members responded to the call for the first meeting, at which a constitution and by-laws were adopted. Arrangements were made with the Division of Adult Education of the City of Sacramento to furnish a public speaking critic. The club was fortunate in getting Mason A. Johnston, of the Sacramento Junior College, to serve in this capacity.

It is the duty of Vice-President E. E. Welsh to select a toastmaster for each meeting. The toastmaster selects from the roster of Secretary William Popper approximately eight to ten speakers for the evening. The length of the speeches is usually five or six minutes. One of the talks generally consists of a ten-minute dissertation on some phase of public speaking previously assigned by the critic.

A typical evening consists of dinner from 6:00 to 7:00 p.m., during which time a small amount of business is conducted, followed by a short recess and the speaking program from 7:00 to 8:30. The remainder of the time until adjournment, about 9:30, is taken up with a discussion by the critic of the talks. The whole group often enters into these discussions, which are lively and instructive. An effort is made to get as many members as possible up on their feet for at least a few comments during the evening.

From our observation of the manner in which the club was accepted, it is our belief that the average engineer is more responsive to a speakers club when it is designed solely for engineers. An effort is made to dispel the classroom atmosphere and to maintain a cordially fraternal feeling throughout the meeting.

The organization of the club, with its constitution and bylaws, has been duly presented to the Sacramento Section and has been officially approved and sponsored by that body as one of its activities. The constitution carries a clause to the effect that the club's activities shall in no way violate any of the rules or ethics of the Sacramento Section or of the Society. The Sacramento Section feels that the club is very worth while and it can heartily recommend its adoption by other Sections.

Manual on Military Roads

LATE in 1939, the Executive Committee of the Highway Division appointed a Committee to prepare material for a manual on the construction and maintenance of military roads in forward areas. It was believed that such a manual would be of interest to all engineers connected with highway construction, and of particular value to our Army engineers.

This manual is now in production and should be ready for distribution to the membership some time in October. It is divided into two sections—one on construction, the other on repair, maintenance and improvement—and covers many aspects of road building, including definitions of materials, equipment, drainage and grading, various types of surface treatment, relation between aggregate and bitumen, bitumen determination, use of portland cement, special expedients for emergency construction, repair and improvement of road surfaces, patching and repair mixtures, and maintenance during the different seasons of the year.

Under the chairmanship of William N. Carey, the committee responsible for this comprehensive manual consists of Oliver J. Todd and M. B. Hodges, Members Am. Soc. C.E.; L. V. Murrow, Assoc. M.; and W. C. Baker, Jr., and B. E. Gray.

At a time when military preparedness and national defense are so important, such a manual on military roads should be especially valuable to members of the Society.

Help for the Program Committee

Suggestions for Use of Local Section and Student Chapter Groups

A SOURCE OF material often overlooked by the program committees of Local Sections and Student Chapters is the papers published monthly throughout the year in PROCEEDINGS. The possibilities of their use will be apparent if the PROCEEDINGS are viewed as preprints (which, in a very real sense, they are), the official final printing being the annual volume of TRANSACTIONS.

The suggestion is made that a paper be selected from the current list of those still open for discussion; and that an acknowledged local expert in that field be selected to explain the paper for oral contemplation and to open the technical discussion.

Then the Secretary of the Section or Chapter can transmit the discussions (if stenographic notes are available) or the names of discussers, to the Editor of PROCEEDINGS, who will cooperate with that discusser in preparing the comments for publication in PROCEEDINGS. It is anticipated that many not students will be sufficiently informed to prepare publishable discussions; but if a faculty sponsor discovers a worthy one (especially on a pertinent question), such discussion should be transmitted to the Editor of PROCEEDINGS by the sponsor, and with this prior endorsement.

It is acknowledged that not all PROCEEDINGS papers may command the local interest required for Local Section technical meetings; but some of them will, and program committees should at least explore this field.

One Local Section sets aside a short part of each meeting for a brief oral review of all current material in PROCEEDINGS and CIVIL ENGINEERING. This idea also deserves consideration.

Special Membership Committees Aid Recent Graduates

EACH YEAR, between the first of June and the first of September, between 500 and 600 applications for Junior Membership are received at Society headquarters from recent graduates of engineering colleges. By that time the men have scattered to the four winds and it is difficult for the nearest local membership committees to gain personal contact with them for the necessary report to the Board.

Beginning three years ago, a special type of local membership committee was authorized, one at the site of each Student Chapter, to insure the requisite personal contact before graduation, and incidentally to relieve the regular local membership committees of work on these simple cases. To date there are 121 Chapters, and the Directors on the Board have appointed 120 Chapter Committees on Graduates, as these committees are called. By the middle of September 102 committees had reported, endorsing 937 potential applicants. Not all of these men will apply to become Juniors but if they do apply within one year of a committee report, their entrance will be considerably expedited. This is but one more instance of definite assistance rendered by members of the Society in behalf of their fellow members and prospective members.

Appointments of Society Representative

E. E. HOWARD, M. Am. Soc. C.E., has been appointed one of the Society's representatives on the Engineers' Council for Professional Development for the three-year term, beginning October 30, 1941.

FALL MEETING of the Society, in Chicago, Ill., October 15–18, with Headquarters at the Palmer House

News of Local Sections

Scheduled Meetings

CLEVELAND SECTION—Luncheon meeting at the Guildhall on October 7, at 12:15 p.m.

DAYTON SECTION—Luncheon meeting at the Dayton Engineers' Club on October 20, at 12:15 p.m.

ITHACA SECTION—Annual meeting at Willard Straight Hall, Cornell University, on October 23, at 6:30 p.m.

METROPOLITAN SECTION—Meeting in the Engineering Societies Building on October 15, at 8 p.m.

MIAMI SECTION—Dinner meeting at the Alcazar Hotel on October 2, at 7 p.m.

MICHIGAN SECTION—Dinner meeting at the Statler Hotel, Detroit, on (date to be decided later), at 7 p.m.

MID-SOUTH SECTION—Fall meeting at Vicksburg, Miss., on October 31 and November 1.

NASHVILLE SECTION—Dinner meeting at Vanderbilt University on October 7, at 6:30 p.m.

NORTHWESTERN SECTION—Dinner at the Minnesota Union on October 6, at 6:30 p.m.; dinner meeting of the Junior Chapter at Ann Unger's Tea Room on October 27, at 6:15 p.m.

PHILADELPHIA SECTION—Dinner meeting at the Engineers' Club on October 14, at 6 p.m.

ROCHESTER SECTION—Dinner meeting at the University Club on October 9, at 6:15 p.m.

SACRAMENTO SECTION—Luncheons every Tuesday at 12:15 p.m.

SAN FRANCISCO SECTION—Dinner meeting at the San Francisco Engineers' Club on October 21, at 5:30 p.m.

SEATTLE SECTION—Dinner meeting at the Engineers' Club on October 27, at 6:30 p.m.

SYRACUSE SECTION—Dinner meeting at the Onondaga Hotel on October 27, at 6:30 p.m.

TACOMA SECTION—Dinner meeting at the Lakewood Community Center on October 13, at 6:30 p.m.

TENNESSEE VALLEY SECTION—Dinner meeting of the Knoxville Sub-Section at the S & W Cafeteria on October 14, at 5:45 p.m.

TEXAS SECTION—Fall meeting at the Texas Hotel at Fort Worth on October 31 and November 1; luncheon meeting of the Dallas Branch at the Dallas Athletic Club on October 6, at 12:10 p.m.

Recent Activities

HAWAII SECTION

Dinner meetings were enjoyed on July 15 and August 19. The speaker at the first of these gatherings was Joel B. Cox, formerly with the McBryde Sugar Company and now a member of the engineering faculty at the University of Hawaii. In a talk entitled "Engineering Aspects of the Sugar Industry" Mr. Cox outlined the history of the industry in the Territory and discussed the unusual problems encountered in Hawaii. During dry periods as much as 200 in. of irrigation water may be required for each cane crop. Engineering designs range from irrigation canals to 500-ft high suspension bridges, from irrigation reservoirs to cesspools. Perfection of mechanical methods for harvesting the cane crop, Mr. Cox pointed out, is one of the biggest problems of the day.

At the August meeting Simon Perliter, chief of the Military Engineering Subdivision of the U.S. Engineer Office, Honolulu District, gave a talk on the planning of the Colorado River Aqueduct. Basing his remarks on personal experiences gathered during his years as designing engineer for the Metropolitan Water District of Southern California, Mr. Perliter discussed the surveys for the project, which were begun in 1923 and entailed mapping an area of 25,000 sq miles. A total of 55 alternate routes was presented to a consulting board before the Parker route was finally chosen. Mr. Perliter then described the design and construction of the Colorado River Aqueduct and Parker Dam. His talk was followed by the showing of a film entitled "Thirteen Golden Cities," which depicted highlights of the project.

NORTH CAROLINA SECTION

The summer meeting of the Section was held in conjunction with a meeting of the North Carolina Society of Engineers at Wrightsville Beach, N.C., on August 1 and 2. Following a business meeting of the North Carolina Society of Engineers on Friday afternoon, August 1, papers were presented by Henry H. Armsby, Field Coordinator of Engineering, Science, and Defense Training in the U.S. Office of Education, and Harry Tucker, professor of highway engineering at North Carolina State College. The former read a paper entitled "The Engineering, Science, and Management Defense Training Program," while Professor Tucker's paper was on "Transportation and City Planning." In the evening there was an informal banquet, at which Thomas J. Hewitt, president of the Wilmington (N.C.) Engineers' Club, acted as toastmaster. The feature of the evening was the presentation of a birthday cake to W. C. Riddick, dean emeritus of engineering at North Carolina State College and former president of the Section. Dr. Riddick spoke briefly, expressing his appreciation of the honor accorded him. The principal after-dinner speaker was Prof. Gustavus Dyer, of Vanderbilt University, who discussed "The Value of Engineers to the Defense Program." On Saturday morning a paper on chlorination was presented by A. P. Rudder, assistant district manager for Wallace and Tiernan, Inc., at Greensboro, N.C. Then Theodore S. Johnson, chief engineer of the Division of Water Resources and Engineering of the State Department of Conservation and Development, discussed "The Floods of August 1940 in North Carolina," in which a number of remarkably heavy runoffs were recorded.

SAN FRANCISCO SECTION

A regular meeting of the Junior Forum of the Section took place on July 29. The possibility of forming a study group to prepare for the fall examinations for civil engineering licenses was discussed, and D. F. Stevens reported on the San Diego Convention. Mr. Stevens represented the Forum at the Convention. The technical program consisted of talks on "Erosion Control Work with the East Bay Municipal Utility District" and "Work with the State Bureau of Sanitary Engineering." These were given by Richard E. Hall and Homer W. Jorgensen, both members of the Forum. The topic of general discussion was, "What Should Be the United States Policy in the Far East?"

TENNESSEE VALLEY SECTION

An evening of motion pictures was enjoyed by the Chattanooga Sub-Section on September 9. Following a skit, illustrated by amusing "stills," films of the Tacoma Narrows Bridge disaster were shown. Features of design and the causes of failure were then discussed by A. T. Granger, professor of civil engineering at the University of Tennessee.

The Knoxville Sub-Section had its regular monthly meeting on September 9. Following dinner a musical program was presented by the Misses Mary E. Edington and Elizabeth McWhorter. The group next enjoyed a color motion picture of the work of the soil mechanics laboratory on Kentucky Dam. The film was shown and explained by M. N. Sinacori, associate materials engineer for the TVA on the construction of the project. Mr. Sinacori also commented on the work done in testing the foundations for the earth embankment, the borrow pit materials, and the final field tests on the completed structure.

TACOMA SECTION

At a meeting held at the Lakewood Community Center on September 9 the Section was pleasantly surprised by the appearance of one of its former members, Glenn L. Parker, who is now stationed in Washington, D.C., as chief hydraulic engineer for the U.S. Geological Survey. After dinner in the main dining room, the meeting was resumed in the downstairs ballroom. Jack Stackhouse, who was in charge of the program for the occasion, introduced the speaker of the evening, Raymond Harsch, assistant manager of the asphalt department of the Shell Oil Company, San Francisco. Mr. Harsch discussed the subject, "Recent Developments and Use of Bituminous Surface Treatments and Pavements on Highways and Streets," illustrating his talk with lantern slides depicting the use of asphalt for such engineering structures as canal linings, revetments, reservoirs, and settling basins. It was announced that Hugh Hurlow, Jr., will act as chairman of the program committee for the rest of the year.

Student Chapter Annual Reports

Abstracts of 1940–1941 Reports from the Southern District as Provided by the Society's Committee on Student Chapters. Other Abstracts Will Appear in the November and December Issues

University of Alabama

During the past year the University of Alabama Chapter was under the able direction of Prof. Donald A. duPlantier, as Faculty Adviser; A. C. Decker, sanitary engineer of the Tennessee Coal, Iron and Railroad Company, as Contact Member; and Warren Bennett, as president of the Chapter. The procedure has been for Mr. Decker to furnish an outside speaker for the first meeting of the month and, whenever possible, he attended the meetings himself.

A custom, which was carried forward from last year, was that of having a committee of three members meet the outside speaker and Mr. Decker and go to dinner with them at a local hotel before the meeting. The members of the committee were alternated thereby giving each man a chance to know and talk with practicing engineers.

Alabama Polytechnic Institute

The spirit and enthusiasm of the members of the Chapter were at their peak during the past year, and many and varied activities were enjoyed. Several meetings were held for the purpose of showing the slides loaned us by the Society, and on these occasions the lecture was given by one of the students. The presentation of student papers was encouraged at all times for the good of the students themselves. The great spirit of our members was shown when we participated in the "civil's" show on the day of the Engineers' Carnival. A show was put on and a small admission charged, the proceeds going for the advancement of the engineering department.

Many of the meetings were made possible and very interesting by the activity of our Contact Member, A. Reese Harvey, who has made many sacrifices to attend the meetings and secure speakers for us.

University of Arkansas

The 1940–1941 school year proved a good one for the University of Arkansas Chapter. Increased activity and interest, curtailed only by scholastic work, were noted. The improvement of the Chapter is attributed to the general interest and to the organization of a well-constructed program. The meeting programs were revised to include the presentation of two papers, at least one current topic, and a group discussion and debate on subjects of importance to the undergraduate engineer. To help in correcting the fallacy that the engineer is a poor speaker, comments were made on the subject matter and delivery of each speaker. "We feel that we have gotten much more out of the Chapter than we have put into it, and appreciate the aid the Society has given us."

Catholic University of America

Membership in the Chapter is entirely voluntary and may include students enrolled in the architectural engineering course as well as those in the civil engineering course. Approximately 31% of the total number of architectural engineering courses is supplied by the architectural department, and about 21% of the total number by the civil engineering department. Such students, as members of the Chapter, have displayed as much interest as the civil engineering students in the welfare and activity of the Chapter.

Comments from the members during the past year would seem to indicate that the individual definitely profits from an informal contact with guest speakers or by entering the general discussion that usually continues the topic of the meeting. Great stress has been placed on this point by our Faculty Adviser, who constantly encourages all members to take the floor, whenever possible, with the idea that too great importance cannot be given the task of acquiring the ability to speak intelligently on engineering topics before an engineering group.

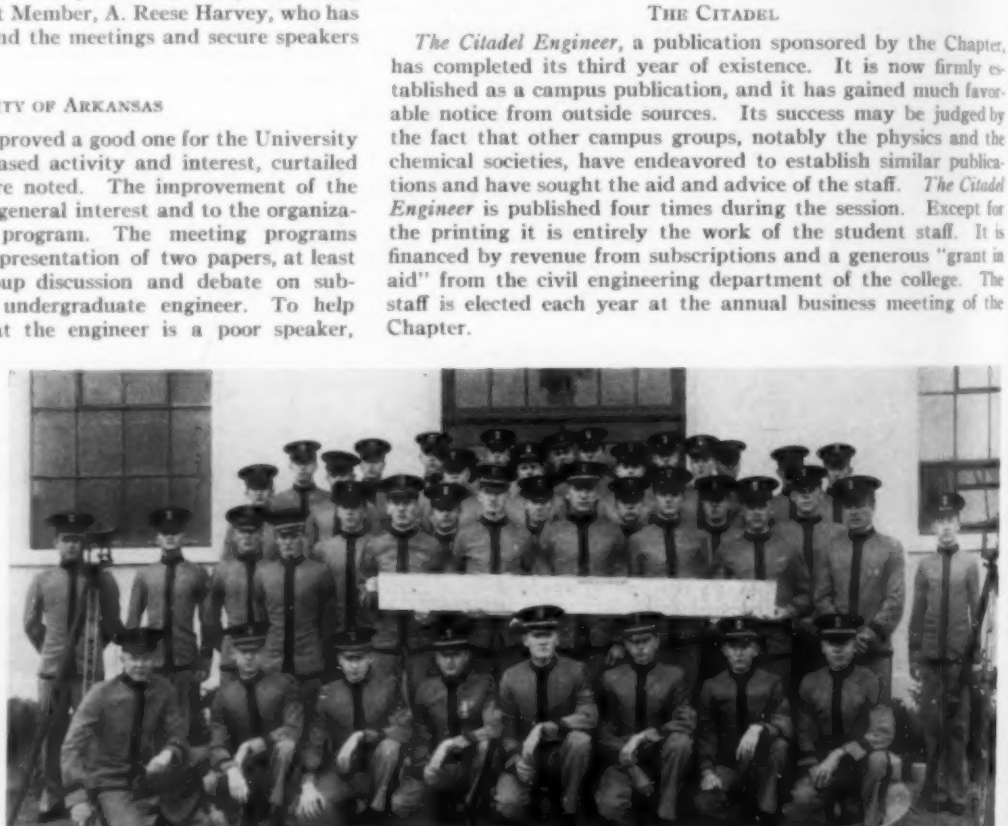
Clemson Agricultural and Mechanical College

This has been one of the most active and satisfactory years in the history of the Student Chapter at Clemson. The members have had good local meetings, well attended as a rule, and have arranged interesting programs for each meeting. Dues were made high enough to pay for about half of the student expense of attending the Society meetings at Cincinnati and at Baltimore. Possibly some students did not join the Chapter because of the three-dollar membership dues, but this seems to be the only way that our Chapter can get student representation at the Society meetings.

"Each year in my annual report I have suggested that some arrangement be made whereby the Society would bear some of the expense of student participation in the meetings. Most of the Faculty Advisers with whom I have discussed the situation agree that something of the sort should be done."

The Citadel

The Citadel Engineer, a publication sponsored by the Chapter, has completed its third year of existence. It is now firmly established as a campus publication, and it has gained much favorable notice from outside sources. Its success may be judged by the fact that other campus groups, notably the physics and the chemical societies, have endeavored to establish similar publications and have sought the aid and advice of the staff. *The Citadel Engineer* is published four times during the session. Except for the printing it is entirely the work of the student staff. It is financed by revenue from subscriptions and a generous "grant in aid" from the civil engineering department of the college. The staff is elected each year at the annual business meeting of the Chapter.



Members of The Citadel Chapter

University of Florida

The Student Chapter at the University of Florida has had a very successful year. The close contact between the students at the meetings, the lectures, field trips, and other activities sponsored by the Chapter have helped greatly to make the year more interesting and beneficial.

The first meeting of the year was merely for organization and a get-together. Prof. W. L. Sawyer welcomed the group and discussed the purpose and aims of the Student Chapter. Each member then introduced himself and related his experience in engineering work during the past summer. The many different types of work represented helped greatly to increase the enthusiasm of the students.

The University of Florida Chapter

George Washington University

The writing of this report brings to a close this Chapter's richest year from an engineering standpoint. That the supply of available engineers is insufficient to meet the demands of the present national emergency must be felt by students at all engineering schools. Our students have had to divert more and more energy from the affairs of the Chapter to the demands of their own work. Statistics show that 80% of our students work in the daytime and attend classes at night. Thus hardly a member of the Chapter has not been hard pressed to keep up with his basic studies. Some of our members have left the city to accept positions of such importance that it would have been impossible to turn them down.

On the part of those who form the nucleus of our membership, however, there has been a keen interest in national affairs and in the effect of those affairs on engineers. Our members have attended various Local Section meetings and Chapter conferences at which the role of the engineer in national defense was discussed and stressed, and at two joint meetings on our own campus the same theme was emphasized. So whatever ideas this Chapter may have had a year ago as to the status, opportunities, and future of civil engineering, it now has a thorough knowledge of existing conditions.

Johns Hopkins University

During the past year the policy of the Johns Hopkins Chapter with regard to meetings has been to include a variety of subjects on the program, in contrast to the previous policy of selecting mainly non-engineering lectures. The meetings have covered a vast field of subjects and have brought speakers from many different professions—engineering, astronomy, medicine, geology are some typical examples. The meetings created such general interest on the campus that on most occasions there was a gratifying attendance of guests.

The officers were particularly fortunate this year in getting co-operation from the members, both in routine work and in the more difficult task of preparing for the regional convention to which our Chapter was host. This convention, held at the same time as the Spring Meeting, was the high light of the year's activities.

Duke University

The Duke University Chapter has just completed a most successful year. There were numerous meetings, and the attendance was very good. We have had several outside guest speakers as well as a number of student speakers. We held our annual "sophomore day"—one of the occasions set aside especially for the presentation of talks by members of the sophomore class. The Chapter participated in the meeting of the Carolina Conference of Student Chapters which was held during the spring at North Carolina State College in Raleigh. We also had three very interesting inspection trips—to the plant of the Carolina Steel and Iron Company, through Fort Bragg, and to Baltimore for a general inspection trip and to attend the Spring Meeting of the Society.

University of Maryland

The University of Maryland Chapter is faced with the problem of poor attendance at its meetings. The poor attendance is due not to lack of interest but rather to the location of the university—between the large cities of Baltimore and Washington—and to the fact that approximately 50% of the members are commuters from these cities. We solved this problem by shifting the day sessions to any convenient time in the week.

It is evident that the Chapter has had a successful year as its activities were many and varied. "However, next year we are looking forward to even greater successes as our Chapter is to be host to the Maryland-District of Columbia Conference of Student Chapters. On behalf of the Chapter, I tender the Society a cordial invitation to meet with us at the conference."

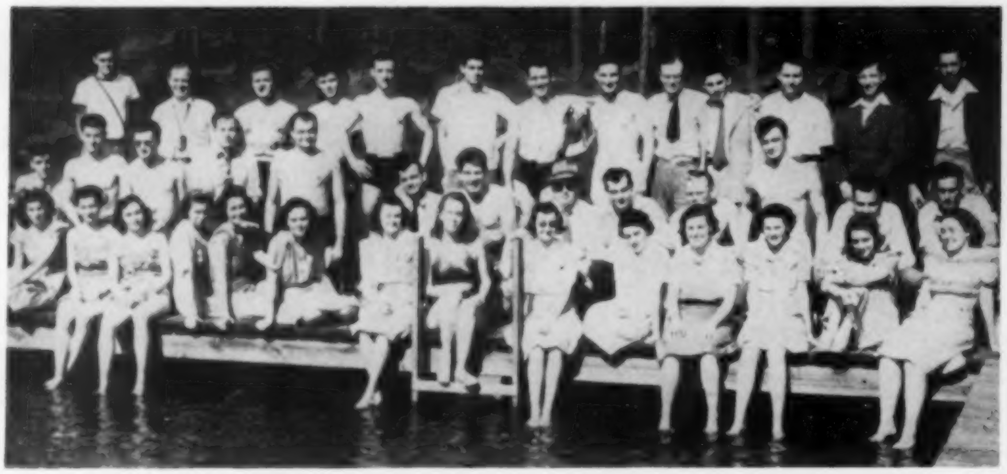
Tulane University

"The Tulane Chapter, during the past year, has endeavored to develop in its members a professional consciousness, a knowledge that engineering is an honorable profession, and that much may be accomplished for both the profession and the individual through membership in an engineering society. In this respect we have striven to make ourselves worthy of our designation as a Student Chapter of the American Society of Civil Engineers. . . . As in the past, the graduating class feels that it would like to continue its identification with the profession of civil engineering and is, therefore, making application for admittance to the Society.

"In times such as these it would seem that a student engineer in college should do his best to prepare himself for the duties and obligations that await him, and it is felt that during the past year the Tulane Student Chapter has contributed to the preparation of its members in this respect.

"It is hoped that the Student Chapter will continue to be an inspiration and stimulus to future members, as it has been to those members who have gone before."

Part of the Tulane Group Aboard the United Dredging Corporation's Dredge "Diesel"



MEMBERS OF NORTH CAROLINA STATE COLLEGE CHAPTER AND "DATES" ON ANNUAL PICNIC AT CRABTREE PARK

NORTH CAROLINA STATE COLLEGE

"We have completed another project in the program of Society construction. The final estimate is herewith submitted. In our review of the year we have seen our mistakes, but rather than as mistakes we have seen them as milestones toward a better organization, an improved understanding....

"This report is a gage by which our progress may be measured in terms of a year's accomplishments. However, the real progress lies in the hearts and minds of our members and as such can be measured only by the fruits of their service in projects yet to come."

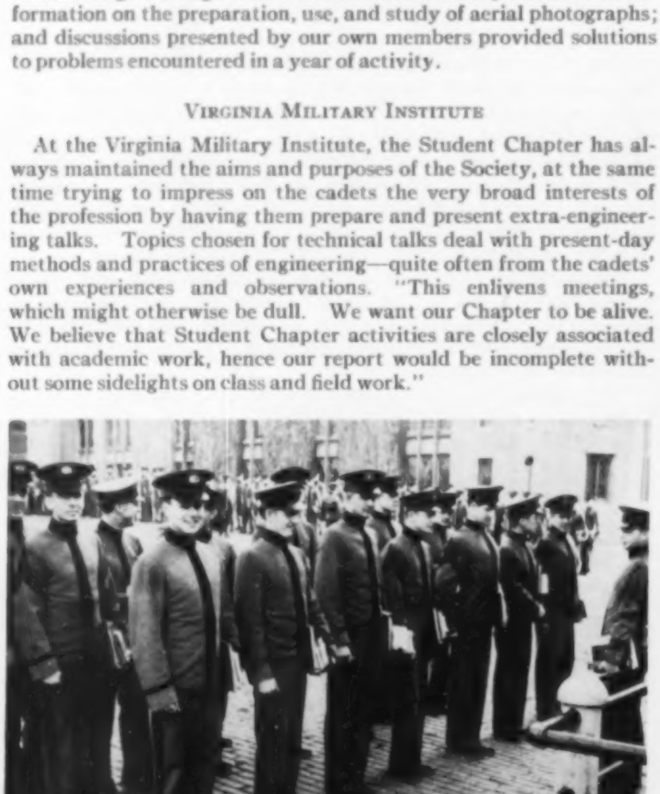
MISSISSIPPI STATE COLLEGE

No single person and no one type of program can be given the credit for the interest shown by students in the activities of an engineering society. There must be contributions from every single member, and there must be a type of program that will hold the interest of these members. It was upon these assumptions that the program for this year was built and carried out by the Mississippi State College Chapter.

Close cooperation between our Faculty Adviser, officers, and committees enabled us to have a series of diversified programs. Lectures on construction, health, and hydraulics were presented by visiting engineers; the Faculty Adviser lectured on road construction; slide lectures furnished by the Society gave some understanding of bridge consteruction methods and problems and information on the preparation, use, and study of aerial photographs; and discussions presented by our own members provided solutions to problems encountered in a year of activity.

VIRGINIA MILITARY INSTITUTE

At the Virginia Military Institute, the Student Chapter has always maintained the aims and purposes of the Society, at the same time trying to impress on the cadets the very broad interests of the profession by having them prepare and present extra-engineering talks. Topics chosen for technical talks deal with present-day methods and practices of engineering—quite often from the cadets' own experiences and observations. "This enlivens meetings, which might otherwise be dull. We want our Chapter to be alive. We believe that Student Chapter activities are closely associated with academic work, hence our report would be incomplete without some sidelights on class and field work."



ASSEMBLY AT VIRGINIA MILITARY INSTITUTE

UNIVERSITY OF TENNESSEE

The Student Chapter at the University of Tennessee has enjoyed a very successful year. As members of the Chapter we have had the opportunity to sit in on lectures, demonstrations, and round-table discussions conducted by men who are eminent engineering authorities. With the national defense program under way and new construction projects springing up, the Chapter has taken full advantage of the opportunity to make inspection trips and observe methods of construction. We are very fortunate to be located in an area where the utilization of electric power is playing such an important part in the defense program. Today the Tennessee Valley is a great monument to engineering construction and, consequently, a large part of the subject matter of our meetings and many of our activities have centered around the TVA.

VIRGINIA POLYTECHNIC INSTITUTE

The Virginia Polytechnic Institute Chapter of the Society has completed one of its most successful years. This has been due largely to a new program that was inaugurated when the Chapter first met on September 26, 1940.

Under the new system the students were to have more of a part in the Chapter. College credit was to be given those students regularly attending meetings and taking part in the programs. Attendance was to be voluntary, and credit was to be awarded as follows: (1) To receive a grade of "A" a student could miss only one meeting, and he must have taken an active part in the meetings; (2) to receive the grade of "B" a student could miss only two meetings, and he must have taken an active part in the meetings; (3) to receive a grade of "C" a student could miss only three meetings, and he must have taken an active part in the meetings; and (4) seniors would receive one credit hour, juniors two-thirds of a credit hour, and sophomores and freshmen one-third of a credit hour for each quarter's work.

WEST VIRGINIA UNIVERSITY

"One of the things that students in all branches of engineering have been trying to do at West Virginia University is to bind all engineering students closer together and to gain more recognition from the rest of the student body.

"One of the greatest attractions of the year at our university is Greater West Virginia Week held on a week-end in May. At this time students of the college of engineering put on the annual Engineers' Show. Mr. Cooksey, a student in the civil engineering department, acted as co-chairman for the show committee, and the civil department gave a very fine account of itself. Parents and other visitors were visibly impressed and left with a high regard for the college of engineering. We feel that this work is very important because it gives people from all parts of the state an opportunity to see our students at work. These people then become a very effective means of 'free advertising' for the entire university as well as the college of engineering."

ITEMS OF INTEREST

About Engineers and Engineering

Civil Engineering for November

Spectacular construction work in the Siskiyou Mountains of northern California is described by F. W. Haselwood, who is district engineer in the State Division of Highways, in charge of highway relocation around Shasta Dam. This work is characterized by heavy cuts and fills and beautiful bridges. Some of the illustrations show construction equipment clinging to side hills in places where it would not be surprising to see mountain goats.

In a field all by itself is the paper by Charles B. Spencer, vice-president of Spencer, White and Prentis, telling about moving a five-story hospital building in New York City. An express highway had the right of way, and it was necessary either to move the building or to tear it down. This paper is a tribute to the skill and daring of engineers and contractors engaged in such breathtaking work. It describes methods that explore a new field and open up the possibility of moving buildings 20 stories high and weighing 15,000 tons.

Part II of J. D. Galloway's article on the life of Theodore Dehone Judah deals with pioneer railroad construction in the West. It sketches the life story of Judah in planning the Southern Pacific Railroad from Salt Lake City across the Great Basin and the Sierras to the young metropolis of Sacramento. Even though Judah died at an early age, he made such a name for himself that he has almost become a legend. Some of the illustrations are museum pieces and portray scenes in vivid contrast to construction work as we know it today.

"Vehicle Behavior" and studies related to the effect of this element on highways and drivers form Part II of J. Trueman Thompson's paper. This describes the other half of the subject, the first being "Driver Behavior," treated in this issue. These studies supply data that will be of interest to road designers all over the country. As a result of such investigations, blind spots and danger zones will eventually be eliminated with a saving in life comparable to that effected by the control of a contagious disease.

Papers on a variety of subjects, including several from Society meetings, will complete the November issue.

Research Fellowship on Fatigue of Metals

A research fellowship on the behavior of metals subjected to combined fatigue stresses is available for the 1941–1942 school year at the Illinois Institute of Technology. This project is sponsored by the Welding Research Committee of the Engineering Foundation. The recipient will receive an annual salary of $650 and free tuition, and will spend half his time on the research project and the other half on work for the M.S. degree. It is likely that the fellowship will be renewed for a second year. An applicant should have a B.S. degree in civil or mechanical engineering and should submit a transcript of his scholastic record, with two letters of reference and a statement of any special qualifications. Applications should be sent to Dr. Joseph Marin, Department of Civil Engineering, Illinois Institute of Technology, Chicago, Ill.

Notre Dame Seniors Adopt Code of Ethics

A notable attempt is made at the University of Notre Dame to instill into senior students of engineering and architecture a proper appreciation of their professional obligations. To this end, weekly meetings and discussions are held, dealing with professional development after graduation. The faculty as well as outside speakers cooperate. Illustrations from actual practice are presented and thoroughly discussed. Among other basic information, the Society's Code of Ethics is subjected to close examination.

In this course it early became apparent to the seniors that the codes of professional ethics devised by the professional engineering societies are of greater value to men who have been in the practice of their profession for ten or more years than to the recent graduate. The seniors therefore were generally quite interested to devise a code to guide the young engineer during the first five years after graduation. After a thorough study of various codes, a group of representative seniors was chosen to incorporate the best points of the many statements into a single code which would provide a practical and working guide for the young engineer and architect immediately after graduation. The following form was unanimously adopted as "The Code of Professional Ethics of the 1941 Notre Dame Engineers and Architects":

"The Engineering Profession, as all other professions, must have a general but efficient standard of ethics if there is to be any unison between the practicing engineer and his neighbor. Moreover it is only proper that the young engineer should have a definite course to follow in his future relationships with clients and fellow professional men. Therefore, we, the graduating class of 1941 from the Engineering College of the University of Notre Dame, propose the following code as a guide along our selected path in life.

"As young engineers we will:

"1. Demonstrate honesty, sincerity, fairness, and honor in all of our professional dealings.

"2. Abstain from all actions which, either directly or indirectly, would detract from the reputation, prospects, or professional undertakings of a fellow engineer.

"3. Place our qualifications as engineers before the public in a dignified and conservative manner.

"4. Consider information which concerns technical data, methods, or processes and business affairs, as well as all information which is not common public knowledge, to be strictly confidential and not within our rights to divulge.

"5. Direct our actions toward the best interests of public welfare and supply our knowledge, skill, and training for the use and benefit of mankind."

Development of this course, with its interesting outcome, was under the direction of D. C. Jackson, Jr., M. Am. Soc. C.E., Dean of the College of Engineering.

Arthur P. Davis Honored

An honor to an engineer is always of interest to engineers. The large dam soon to be constructed by the U.S. Bureau of Reclamation on the Colorado River about thirty miles south of Boulder Dam is to be named Davis Dam in honor of the late Arthur Powell Davis, Past-President of the Society. As director of the Reclamation Service (now the Bureau of Reclamation), Mr. Davis laid the foundation for the planned development of the Colorado through his report in 1922, in which he recommended the construction of Boulder Dam and the All-American Canal. Announcement of the designation of the new dam was made by Secretary of the Interior Harold L. Ickes on June 26.

During the period 1884 to 1902 Mr. Davis was with the Geological Survey, from which he was transferred to the Reclamation Service when the Reclamation Act was approved in 1902. In 1914 he was appointed director and chief engineer.

Long a member of the Society, Mr. Davis served as Director from 1917 to 1919, and was President in 1920. He died on October 8, 1933.

Prof. N. G. Neare's Column

Conducted by

R. Robinson Rowe, M. Am. Soc. C.E.

As usual, our October dinner meeting attracted a lively crowd of engineers—each to share his vacation golf and fishing with his equally braggart fellows. But Professor Neare surmised that several who liquidated their pumpkin pie with conspicuous solemnity were saving voice for an argument on the price of pipe.

"I suspect," he began, "that we are to hear the case of People v. Mayter. Two

months ago I quoted two claims of this S. T. Mayter, the first being that he had deduced a proper quotation for a lot of three kinds of pipe from quotations on two other lots after prices had been frozen. Do the People challenge that?"

"I say he couldn't have done it," led Amos Keatow. "If x, y, and z are prices in cents per foot for 4-in., 5-in., and 6-in. pipe, respectively, and L is the required quotation in dollars, then:

$$5{,}000x + 3{,}000y + 1{,}000z = 97{,}000 \ldots (1)$$
$$1{,}000x + 4{,}000y + 7{,}000z = 135{,}000 \ldots (2)$$
$$4{,}000x + 5{,}000y + 6{,}000z = 100L \ldots (3)$$

For the four unknowns, he needed another equation or condition, so he specified that the unit prices were not fractional. This isn't enuf, because there are 15 sets of such prices that will satisfy the equations."

"He's pretty near right," countered J. W., "but each set makes L equal \$1,660. So Mayter is all right on that claim."

"I check on that," said R. J. "Ad 11 times Eq. 1 to 13 times Eq. 2 and divide thru by 17 to get:

$$4{,}000x + 5{,}000y + 6{,}000z = 166{,}000\text{"} \ldots (4)$$

"Incidentally," put in the Professor, "this is possible because the three equations are not independent, since:

$$\left.\begin{matrix} 5{,}000 & 3{,}000 & 1{,}000 \\ 1{,}000 & 4{,}000 & 7{,}000 \\ 4{,}000 & 5{,}000 & 6{,}000 \end{matrix}\right| = 0 \ldots\ldots (5)$$

"Hearing no rebuttal so far, let's proceed to Mayter's second deduction—'the price for one foot of each kind of pipe.' Now what say the People?"

Amos Keatow challenged again. "I mentioned 15 sets of prices that satisfied the equations without being fractional. Well, every set is screwy. The price for 5-in. pipe will either exceed that for 6-in. or be less than that for 4-in. The best set is 10 cents per ft for 4-in., 12 cents for 5-in., and 11 cents for 6-in."

"That's right," chorused the People.

"Price-fixing itself may be just as screwy and inconsistent," contended the Professor, "and you may quote me on that. Suppose the OPACS fixed the price of 4-in. and 6-in. pipe when dormant 5-in. pipe would have brot 10.5 cents. Then suppose 5-in. pipe upped to 12 cents before it was tagged. Suppose, on the other hand, that Mayter was thinking of something else."

"I have it," exclaimed George. "Eqs. 1 and 2 can be combined to give:

$$x + y + z = 33 \ldots\ldots\ldots\ldots (6)$$

So 33 cents is the price for one foot of each kind of pipe."

"By adding three times the first equation to twice the second and dividing by 17 again," pointed out R. J.

"Precisely," concluded Professor Neare, "and no matter whether x, y, and z are integers or not, so that there was 'more than enuf data.' Now, before we are swamped by rebuttal, here's a new problem with smaller numbers and no catch to it.

"In a compact industrial area being organized for defense, there are five cities so located that each is exactly a whole number of miles from each of the other four cities and all are interconnected with straight highways. I. C. Dailey is a supervising engineer living in Aburg, one of the cities. Overseeing projects in each of the other cities, he drives every morning from Aburg 12 miles to Bopolis, then 15 miles south to Cville, then 5 miles to Delphia, then 7 miles to Etown, then 7 miles to his home.

"His efficient assistant, our old friend Titus Wadhouse, pointed out that Dailey could save 10 miles on each trip if he visited his projects in the order Delphia, Bopolis, Etown, and Cville—starting and finishing at Aburg, of course. Can you map the cities and highways?"

[*Only two complete solutions were received—from George, who is George Paaswell, and R. J., our recent Guest Professor, Richard Jenney. Many solutions to the first part were received, the earliest from J. W., who is J. W. Pickworth, followed closely by R. C. Hudson, D. E. Hughes, Cuyler Lush, and L. J. Bevan. The other characters are fictional.*]

NEWS OF ENGINEERS

Personal Items About Society Members

WORD of still more members of the Society in the Officers Reserve Corps of the Army, who have been ordered to active duty, has been received at Society Headquarters. The list includes Lt. Col. R. R. Litehiser, from chief engineer of tests for the Ohio State Highway Department, Columbus, Ohio, to active duty in the Field Artillery; Maj. Carl T. Baer, from Dallas, Tex., to active duty with the Zone Constructing Quartermaster at Fort Sam Houston, Tex.; Capt. Rolland A. Philleo, from structural engineer for the Bechtel-McCone-Parsons Corporation of Los Angeles, Calif., to the 529th School Squadron, Air Corps Basic Flying School, Bakersfield, Calif.; Capt. Arthur E. Stanley, from the Stanley Engineering Company of Muscatine, Iowa, to the Air Corps Advanced Flying School at Phoenix, Ariz.; and Lt Harold A. Lewin, from assistant section engineer for the New York City Board of Water Supply, to the engineer headquarters of the Alaskan Air Force at Fort Richardson, Alaska.

ALDEN G. ROACH is now president of the Consolidated Steel Corporation, Ltd., with offices in Los Angeles, Calif. He had previously been executive vice-president at Beaumont, Tex.

L. M. WINSOR recently sailed for Teheran, Iran, where he will serve as special consultant to the government of Iran in the planning of water conservation and irrigation development. He was formerly with the U.S. Bureau of Biological Survey at Salt Lake City, Utah.

GEORGE C. ERNST has resigned as assistant professor of civil engineering at the University of Maryland in order to accept a similar position in the college of applied science at Syracuse University. He succeeds CECIL S. CAMP who resigned during the summer to accept a position with the University of Tennessee.

AUGUSTUS GRIFFIN, chief engineer of the Department of Natural Resources for the Canadian Pacific Railway at Alberta, Canada, has been appointed to the additional post of assistant manager of the department. His headquarters are now at Calgary.

ROLAND H. WILLCOMB, formerly secretary and executive director of the Great Falls (Mont.) Housing Authority, is now division engineer for the Montana State Highway Commission, with offices at Lewistown, Mont.

GEORGE GUY KELCEY, since 1931 sales manager of the Signal Service Corporation, Elizabeth, N.J., has resigned from that position in order to become president of Vehicular Parking, Ltd., Newark, N.J.

WILLIAM D. SHANNON has been appointed Seattle District Manager of the Priorities Division of the Office of Production Management. His office will be in the Stuart Building, Seattle, Wash.

JOSEPH H. EHLERS is now technical specialist in the Construction Unit of the Bureau of Foreign and Domestic Commerce, of the U.S. Department of Commerce, Washington, D.C. He was formerly with the consulting firm of Modjeski and Masters.

JAMES A. ANDERSON, head of the department of civil engineering at Virginia Military Institute, has been appointed Virginia State Highway Commissioner, succeeding the late HENRY G. SHIRLEY.

PAUL C. BENEDICT, associate engineer for the U.S. Geological Survey, has been transferred from the Boise (Idaho) District to the Iowa City District, where he will represent the Survey in the development of new silt-sampling equipment and procedure at the Institute of Hydraulic Research at the University of Iowa.

LLOYD W. WEED, formerly structural engineer for the Portland Cement Association, of New York, N.Y., has joined the staff of the Wait Associates, Inc., with headquarters in the same city.

WALTER D. BINGER, Commissioner of Borough Works of the Borough of Manhattan, is now in England on some special investigations for the War Department. As an expert consultant to the Secretary of War, Mr. Binger has been given authority to observe and report on a wide variety of technical engineering aspects of civilian protection. He is chairman both of the Society's Committee on Civilian Protection in War Time and of the National Technological Civil Protection Committee.

CHARLES P. WILLIAMS has been made engineer in charge of construction of San Vicente Dam, a part of the augmented water supply of San Diego, Calif.

JACOB L. CRANE, JR., represented the American Committee for the International Union of Local Authorities at the Second Inter-American Congress of Municipalities, which was held in Santiago, Chile, September 15 to 21. Mr. Crane is assistant coordinator of defense housing for the U.S. Housing Authority, Washington, D.C.

Richard M. Merriman has established a consulting practice in the Petroleum Building, 714 West Olympic Boulevard, Los Angeles, Calif., where he will specialize in heavy engineering construction. Mr. Merriman was formerly chief tunnel engineer for the Pennsylvania Turnpike Commission.

Robert H. Dodds is now a junior engineer in the U.S. Engineer Office at Wright Field, Dayton, Ohio.

George M. Haley has been granted a leave of absence by the Salt Lake County Commission, for which he has been serving as county engineer and surveyor, in order to serve as engineer on the small arms ammunition plant being constructed by Smith, Hinchman and Grylls, Inc., Detroit engineers.

William B. Hill, until recently associate highway engineer for the U.S. Indian Service at Oklahoma City, Okla., has been appointed superintendent of the Seminole Indian agency at Dania, Fla.

Edward B. Snell, who is on the civilian staff of the U.S. Engineer Office, has been placed in charge of the Albany (N.Y.) area. He was formerly principal engineer in the U.S. Engineer Office in New York City, N.Y.

S. C. Jacka has resigned as city engineer of Lansing, Mich., in order to take an active part in the work of the Francis Engineering Company, of Saginaw, Mich.

Reeves Newsom, New York City consultant, announces that E. H. Aldrich, his principal assistant since 1938, has become his partner in the firm of Newsom and Aldrich.

David McCoach, Jr., colonel, Corps of Engineers, U.S. Army, is now executive assistant in the Office of the Chief of Engineers, Washington, D.C. He was formerly engineer commissioner for the District of Columbia.

Ira D. S. Kelly, major, Corps of Engineers, U.S. Army, has been transferred from Fort Riley, Kans., to Fort Leavenworth, Kans., with orders to assume the duties of Constructing Quartermaster.

DECEASED

Edward Morris Bassett (Assoc. M. '16) vice-president of Wark and Company of Philadelphia, Pa., died at Swarthmore, Pa., on August 16, 1941. Mr. Bassett, who was 58, joined Wark and Company in 1918. Prior to that he had been with the Pennsylvania Railroad and the federal government.

George Sydney Binckley (M. '10) who for many years maintained a consulting practice in Los Angeles, Calif., died on May 1, 1941, at the age of 70. Mr. Binckley had served as consultant to many organizations and municipalities in this country, Mexico, and Canada, these affiliations including the Los Angeles Gas and Electric Company, the city of San Francisco, the British Columbia Electric Railway, and the Vancouver Power Company. During the war he served overseas and, later, was assigned the rank of colonel in the Officers Reserve Corps of the Army.

Eduardo Justo Chibas (M. '00) consulting engineer of Havana, Cuba, died in that city on August 22, 1941, at the age of 72. A native of Cuba, Mr. Chibas was educated in the United States. He was noted for his work on railway, mining, and irrigation projects in Cuba, Panama, Colombia, and Venezuela. During the Spanish-American War he served as an engineer with the Fifth Army Corps of the United States.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

Ernest Werner Eickelberg (M. '35) lieutenant commander, U.S. Coast and Geodetic Survey, Washington, D.C., died in Baltimore, Md., on May 20, 1941. He was 51. Except for a two-year period of service in the U.S. Army during the World War, Mr. Eickelberg had been with the Coast and Geodetic Survey since 1913. From 1932 to 1938 he was assistant chief of the Division of Terrestrial Magnetism and Seismology of the Survey, and from 1938 on was commanding officer in charge of surveys in the Bering Sea.

Walter Thomas Evans (Assoc. M. '28) chief valuation engineer for Los Angeles County (California), died at Glendale, Calif., on August 9, 1941. Mr. Evans, who was 53, had been in the County Engineer's Department since 1927. Before that (1916 to 1923) he was office engineer for the Chicago and Alton Railroad, with headquarters in Chicago.

Howard Cecil Lee Humphreys (M. '32) a member of the firm of Howard Humphreys and Sons, of Berkshire, England, died on July 18, 1941, at the age of 47. Except for interruptions for war service, Colonel Humphreys was in his father's firm from 1911 on—since 1925 as a partner. During the World War he saw service on the Western front and in Salonika and Palestine. In the present war he was chief signal officer to the 3rd Corps, and in 1940 was appointed Director of Works at the Ministry of Works and Buildings.

Wilson Sherman Kinnear (M. '06) retired civil engineer, died at his home in Grosse Pointe, Mich., on August 8, 1941. Mr. Kinnear, who was 77, for many years maintained a consulting practice in New York. In 1912 he was the recipient of the Society's Norman Medal.

George Travilla MacNab (Assoc. M. '97) retired civil engineer of New York City, died there on August 1, 1941. Mr. MacNab, who was 75, was for a number of years assistant engineer of highways in the Borough of the Bronx.

Charles Hamilton Mitchell (M. '04) who retired a few months ago as dean of the Faculty of Applied Science and Engineering at the University of Toronto, died in Toronto on August 26, 1941. He was 69. General Mitchell served with the Canadian armies in France during the World War, advancing to the rank of brigadier general. At the end of the war he was made dean at the University of Toronto and for many years, also, maintained a consulting practice in Toronto. He was a former president of the Engineering Institute of Canada.

Robert Justice Paulette (M. '26) consulting engineer (Paulette and Wilson), of Topeka, Kans., died suddenly in Colorado Springs, Colo., on August 28, 1941. He was 55. Mr. Paulette had been with the U.S. Bureau of Reclamation; Black and Veatch, of Kansas City; and the Anaconda Copper Mining Company. He was city engineer and superintendent of utilities for the city of Emporia, Kans., from 1922 to 1925, and director of public works for the city of Salina, Kans., from 1925 to 1931. In the latter year he entered private practice. During the war Mr. Paulette was in the Corps of Engineers, U.S. Army, with the rank of captain.

Walter Percival Rice (M. '89) retired engineer of Cleveland, Ohio, died in Atlantic City on August 21, 1941, at the age of 85. Mr. Rice was city engineer of Cleveland from 1887 to 1890 and from 1893 to 1895. At one time he served as chief engineer for the state of Ohio, and from 1901 until his retirement he maintained a consulting practice in Cleveland. Founder of the Cleveland Engineering Society, Mr. Rice served as president of that organization in 1892 and 1893.

Henry Ryon (M. '23) retired civil engineer of Albany, N.Y., died in that city on July 31, 1941, at the age of 59. For some years Mr. Ryon was in the New York State Department of Public Works, and at the time of his retirement in 1936 was senior assistant engineer.

Harold C. Webster (Assoc. M. '30) consulting civil engineer of Milwaukee, Wis., died in that city on August 27, 1941. Mr. Webster, who was 55, had been in private practice since 1911, specializing in county and municipal work. Part of the time during this period he was, also, county surveyor of Milwaukee County and city engineer of North Milwaukee.

Henry John Wenderoth (Jun. '37) junior topographic engineer for the U.S. Geological Survey, Sacramento, Calif., died at Salem, Ore., on July 2, 1941. Mr. Wenderoth, who was 26, had been with the Geological Survey since his graduation from Oregon State College in 1937.

Ernest Woodbury Wiggin (M. '14) consulting engineer of Ventura, Calif., died on August 31, 1941, at the age of 69. Mr. Wiggin was in the employ of the New York, New Haven, and Hartford Railroad from 1895 to 1908. He was then with the New York firm of Westinghouse, Church, Kerr and Company and with the Boston and Albany Railroad before entering the consulting field—in 1914.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From August 10 to September 9, 1941, Inclusive

Additions to Membership

Barnard, Charles Clifton (Assoc. M. '41), (Barnard, Godat & Heft), 314 Terminal Station Bldg., New Orleans, La.

Beardslee, Edward McClelland (Assoc. M. '41), 921 Littleton St., Augusta, Ga.

Blitz, Joseph Phillip (Assoc. M. '41), (Bakert Constr. Co.), 545 Fifth Ave., New York, N.Y.

Butterfield, Stephen Ernest (Assoc. M. '41), Traffic Engr., State Highway Dept., State Office Bldg., Hartford (Res., 74 Newport Ave., West Hartford), Conn.

Cajanus, Carl Arvid (M. '41), City Engr., City Hall, Wisconsin Rapids, Wis.

Castella, William Floyd (Jun. '41), Senior Office Engr., City Eng. Dept., City Hall (Res., 401 Louisiana), Corpus Christi, Tex.

Cooke, James Barry (Jun. '41), Eng. Asst., Pacific Gas & Elec. Co., 245 Market St., San Francisco, Calif.

Corr, Francis John, Jr. (Assoc. M. '41), (Francis J. Corr & Son), 732 Clark St., Lansing, Mich.

Dalton, Carl Richard (Assoc. M. '41), Associate Engr., U.S. Indian Field Service, Whiteriver, Ariz.

Donlon, Thomas Francis (Assoc. M. '41), Lt. (jg) CEC-V (S), U.S.N.R., Asst. to Public Works Officer, 9th Naval Dist., Great Lakes, Ill.

Fiscus, David Homer (Assoc. M. '41), Div. Engr., California Water & Telephone Co., 19 West 9th St., National City, Calif.

Fisher, Donald Moore (Jun. '41), Junior Valuation Engr., State Tax Comm. (Res., 378 Bellevue St.), Salem, Ore.

Fletcher, Thomas (Assoc. M. '41), Roadmaster, Baltimore Transit Co., 1300 Bush St. (Res., 5309 Gwynn Oak Ave.), Baltimore, Md.

Fremouw, Gerrit Dangremond (Assoc. M. '41), Dist. Director of Operations, WPA, Federal Works Agency, 44 Marshall St., Rochester (Res., 322 Vienna St., Newark), N.Y.

Garanflo, George Edwin (Assoc. M. '41), Airport Engr., Civ. Aeronautics Administration, 619 Rhodes Bldg. (Res., 61 Sixteenth St., N.E.), Atlanta, Ga.

García-Quintero Andrés (Jun. '41), Civ. Engr., Comision Nacional de Irrigacion, Balderas 94 (Res., Monte Alban 6, Colonia Narvarte), Mexico City, Mexico.

Goebel, Andrew Scheihing (M. '41), City Engr., City Hall, Savannah, Ga.

Gooding, William James, Jr. (M. '41), Bridge Engr., State Highway Dept. (Res., 1500 Shirley St.), Columbia, S.C.

Gunn, Donald (Assoc. M. '41), Asst. to Chf. Engr., Pennsylvania Water & Power Co., 1610 Lexington Bldg., Baltimore, Md.

Gutierrez-Salinas, Jorge Braulio (M. '41), Civ. Engr., Dept. of Public Works, Argentine Govt., 9 de Julio 1925-Piso 22 (Res., Santa Fe 951-1° piso), Buenos Aires, Argentina.

Hamilton, George Washington (Assoc. M. '41), Associate San. Engr., TVA, 515 Union Bldg. (Res., 1731 Valley View Rd.), Knoxville, Tenn.

Hammond, Robert James (Jun. '41), Junior Engr., Lago Petroleum Corp., Apartado 172, Maracaibo, Venezuela. (Res., 163 Wilkinson Ave., Jersey City, N.J.)

Harvie, William Henry (M. '41), Road Engr., State Highway Dept., Lansing (Res., 912 Glenhaven, East Lansing), Mich.

Henderson, Mark Hyrum (Jun. '41), Burlington, Wyo.

High, Lester Grayson (Jun. '41), Junior Structural Engr., TVA, 300 Arnstein Bldg., Knoxville, Tenn.

Hoff, William Henry Barnes (Assoc. M. '41), Engr., Const. Quartermaster, U.S. Army, Camp Bowie (Res., 1016 Ave. K, Brownwood), Tex.

Jorgensen, Leonard Nielsen (Jun. '41), Junior Hydr. Engr., U.S. Geological Survey, 300 Highway Bldg., Austin, Tex.

Kelley, George Larry (Jun. '41), Engr., Design Office, Black & Veatch (Res., 701 South 24th St.), Fort Smith, Ark.

Knapp, Charles Albert (Jun. '41), Junior Engr., U.S. Engrs., (Res., 534 Osborn Blvd.), Sault Ste. Marie, Mich.

Kullerside, Olav (Assoc. M. '41), Designer, Hydr. Div., Ebasco Services, Inc., 2 Rector St., New York (Res., 6818 Bliss Terrace, Brooklyn), N.Y.

Larson, Fred Herman (Assoc. M. '41), Area Engr., SCS, U.S. Dept. of Agriculture, Realty Bldg. (Res., West 617 Fourteenth St.), Spokane, Wash.

Legault, Adrian Raymond (Assoc. M. '41), Asst. Prof., Civ. Eng., Colorado State College, 220 Pitkin, Fort Collins, Colo.

Lipinski, Edward Eugene (Assoc. M. '41), Engr., James Stewart & Co., Inc., Box 1, Sparrows Point, Md.

Lobdell, Arthur Treadway (M. '41), Maj., Corps of Engrs., U.S. Army, 1845 Euclid Ave., Lincoln, Nebr.

Long, George Stevenson (Assoc. M. '41), Designing Engr., Havens & Emerson, Leader Bldg., Cleveland, Ohio.

Lutrick, Reece Richard (Assoc. M. '41), Design and Estimating Engr., Mosher Steel Co., Maple Ave. (Res., 3316 Stanford Ave.), Dallas, Tex.

Mackintosh, Albyn (Assoc. M. '41), Civ. Engr. (Mackintosh & Mackintosh), 306 North Vermont Ave. (Res., 4380 York Blvd.), Los Angeles, Calif.

McClellan, Merritt Charles (Assoc. M. '41), Associate Topographic Engr., U.S. Geological Survey, 706 Mining Exchange Bldg., Denver, Colo. (Res., Arlington, Nebr.)

Martin, Park Hussey (M. '41), Planning Engr., Allegheny County Planning Comm., County Office Bldg., Pittsburgh, Pa.

Matthews, John Thompson (Jun. '41), Engr., Alabama Water Service Co., 1300 Watts Bldg., Birmingham, Ala.

Mercer, Robert Tressler (Jun. '41), Engr. Salesman (Steel), Mercer Steel Co., Inc., 838 North West 13th Ave., Portland, Ore.

Moss, John Parker (M. '41), Pres., Moss-Thornton Co., Inc., 985 Conroy Rd., Birmingham, Ala.

Niotis, Demetrios John (Assoc. M. '41), Structural Designer, Water Works Div., City of Chicago, 402B City Hall, Chicago, Ill.

Oliver, Warren Joseph (Jun. '41), Junior Engr., U.S. Bureau of Reclamation, Friant, Calif.

Parker, Homer Martin (Assoc. M. '41), Field Engr., Portland Cement Assn., 1528 Walnut St., Philadelphia, Pa. (Res., 300 East 30th St., Baltimore, Md.)

Pendergrass, John Thomas (Assoc. M. '41), Asst. Railroad Engr., Howard, Needles, Tammen & Bergendorf, Southwest Proving Grounds, 921 South Walnut, Hope, Ark.

TOTAL MEMBERSHIP AS OF SEPTEMBER 9, 1941	
Members	5,755
Associate Members	6,760
Corporate Members	12,515
Honorary Members	32
Juniors	4,569
Affiliates	70
Fellows	1
Total	17,187

Perez Guerra, Gustavo Luis (Jun. '41), Civ. Engr., Div. de Acueductos, Minesterio de Obras Publicas (Res., Cuartel Viejo a Pineda 31), Caracas, Venezuela.

Pfeil, Arthur Elton (Jun. '41), Structural Designer, Arthur G. McKee & Co., 2300 Chester Ave., Cleveland (Res., 1747 Page Ave., East Cleveland), Ohio.

Prusak, Bernard Roy (Jun. '41), 215 Walnut South East, Minneapolis, Minn.

Reece, George Matthew (Jun. '41), Asst. San. Chemist, Bureau of Water, Dept. of Public Works, 242 Chestnut St. Pier, Philadelphia, Pa.

Reyes, Enrique Garcia (M. '41), Carrera 14 37-08, Bogota, Colombia.

Rich, Albert Barzillai (Assoc. M. '41), Engr., Ganteaume & McMullin, 99 Chauncy St., Boston (Res., 12 Tyler St., North Quincy), Mass.

Rippstein, Edwin Eugene (Assoc. M. '41), Care Laclede Steel Co., 1317 Arcade Bldg., St. Louis, Mo.

River, Robert Beaudon (Assoc. M. '41), Asst. Civ. Engr., U.S. Engr. Dept., 751 South Figueroa St., Los Angeles, Calif.

Smith, Thomas Sherburne, Jr. (Jun. '41), 2d Lt., Corps of Engrs., U.S. Army, Brookley Field, Mobile, Ala.

Spencer, Ernest Lincoln (Jun. '41), Instr., Civ. Eng., Northeastern Univ., 360 Huntington Ave., Boston, Mass.

Squire, Andrew Bradford Pierson (M. '41), Treas., Wm. S. Lozier, Inc., 10 Gibbs St., Rochester, N.Y.

Stein, Philip Charles (Assoc. M. '41), Instr., Mass. Inst. Tech., Cambridge, Mass.

Thomas, David Pyper (Assoc. M. '41), Lt., U.S. Army, Post Utility Officer, Ogden Air Depot, Hill Field, Ogden, Utah.

Thompson, Joe Earl (Jun. '41), Chf. of Party, Natural Gas Pipeline Co. of America, Great Bend, Kans.

Voigt, William Adam (M. '41), Engr., Bridge Design, State Highway Dept., 746 Administration Bldg., Lansing, Mich.

von Schlatzer, Robert Karl (Jun. '41), Asst Highway Engr., U.S. Public Roads Administration, Federal Works Agency, Apartado Q, San Jose, Costa Rica.

Wagner, William Chauncey (M. '41), Associate Prof., Civ. Eng., Univ. of New Mexico, Albuquerque, N.Mex.

Weiss, Burrage (Assoc. M. '41), Supt., Vinson & Pringle, 2020 West Grant St., Phoenix, Ariz.

Whalen, William Edward (M. '41), Constr. Engr., The Elec. Auto-Lite Co. (Res., 1949 Foster Ave.), Toledo, Ohio.

Membership Transfers

Arledge, Albert Ross (Assoc. M. '22; M. '41), Prin. Civ. Engr., Los Angeles Bureau of Power & Light, Box 3669 Terminal Annex, Los Angeles (Res., 1842 Rose Villa St., Pasadena), Calif.

Blaschke, Edwin Henry (Jun. '35; Assoc. M. '41), Job Office Engr., The Foundation Co., Box 126 (Res., 35 Agawam Rd.), Quincy, Mass.

Brown, Walter Augustus (Jun. '32; Assoc. M. '41), Office Engr., U. B. Converse & Co., Inc. City Hall, Port Arthur, Tex.

Campbell, Thomas Herbert (Jun. '34; Assoc. M. '41), Associate Prof., Civ. Eng., Univ. of Alaska, College, Alaska.

Carter, Vernon Lee (Jun. '36; Assoc. M. '41), Asst. Engr., Div. Office, State Highway Comm., Salina (Res., Carlton Hotel, Lindsborg), Kans.

Clinton, Frank Mark (Jun. '34; Assoc. M. '41), Associate Engr., U.S. Bureau of Reclamation, Box 456, Worland, Wyo.

Cook, Howard Lee (Jun. '31; Assoc. M. '34; M. '41), Technical Adviser on Hydrology, Office of Land Use Coordination, U.S. Dept. of Agriculture, Washington, D.C. (Res., 5005 Wilson Lane, Bethesda, Md.)

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COX, CLIFFORD BUGBEE (Jun. '31; Assoc. M. '41), Chf. Engr., Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

DEMENT, JAMES WASHINGTON, JR. (Jun. '36; Assoc. M. '41), Capt., Corps of Engrs., U.S. Army, U.S. Engr. Office, Mobile, Ala.

DUNCAN, CHARLES FREEMAN (Jun. '30; Assoc. M. '41), Civ. Engr., Office, Div. Engr., South Atlantic Div., U.S. Army, Box 1337, Richmond, Va.

FARMER, EDWARD AUGUST (Jun. '29; Assoc. M. '41), Res. Engr., Black & Veatch, 4706 Broadway, Kansas City, Mo.

GARDNER, LEIGH OWEN (Jun. '33; Assoc. M. '41), Designing Engr., Headman, Ferguson & Carollo, 319 Homebuilders Bldg. (Res., 215 South 22d Ave.), Phoenix, Ariz.

GIBSON, EDWIN EMMONS (Jun. '31; Assoc. M. '41); Lt. (jg) CEC, U.S.N.R., Headquarters 8th Naval Dist., Federal Office Bldg., New Orleans, La.

GURLEY, LEON RAYMOND (Assoc. M. '28; M. '41), Senior Engr., Coverdale & Colpitts, 120 Wall St., New York, N.Y.

HAYES, HOWARD MAXWELL (Jun. '37; Assoc. M. '41), Chf. Civ. Engr., Ford, Bacon & Davis, 11½ North Laurens St. (Res., 129 East Ave.), Greenville, S.C.

HOLLICK, ROBERT EBENEZER (Jun. '30; Assoc. M. '41), Associate Structural Engr., Special Eng. Div., Panama Canal, Diablo Heights, Canal Zone.

KADOW, ROBERT JOHN (Jun. '23; Assoc. M. '30; M. '41), Structural Engr., S. B. Barnes, 803 West 3d St., Los Angeles (Res., 10452 Otsego St., North Hollywood), Calif.

KNAPP, LLOYD DUNAWAY (Assoc. M. '28; M. '41), Special Asst. Engr., Bureau of Engrs., City of Milwaukee, 202 East Wells St. (Res., 2947 North 47th St.), Milwaukee, Wis.

KNOX, JEAN HOWARD (Assoc. M. '15; M. '41), Consultant and Concrete Technician, Byrne Organization, Box 629, Naval Operating Base, Norfolk, Va.

LAZENBY, ARTHUR J. (Jun. '35; Assoc. M. '41), 1st. Lt., Company B, 5th Battalion, Engr. Replacement Training Center, Fort Belvoir (Res., 411 South Wayne St., Arlington), Va.

LOWE, THOMAS MARVEL (Assoc. M. '31; M. '41), Head, Dept. of Civ. Eng., Alabama Polytechnic Inst., Auburn, Ala.

MCNAUGHTON, WILLIAM CARLTON (Assoc. M. '18; M. '41), Asst. Engr., New York City Transit System, Board of Transportation, 2545 Seventh Ave., New York, N.Y.

MATHEWS, CLAUDE KELSEY (Assoc. M. '24; M. '41), Prin. Engr., Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Room 300, Kansas City, Mo.

MILLIRON, WILLIAM RALPH (Jun. '38; Assoc. M. '41), 2101 Veteran Ave., West Los Angeles, Calif.

NEWMAN, EDWIN MAHLON (Jun. '33; Assoc. M. '41), Detailer-Checker, Harrington & Cortelyou, 1004 Baltimore Ave., Kansas City, Mo.

PERRY, CLIFTON BENOIT (Jun. '36; Assoc. M. '41), Eng. Insp., Board of Water Supply, City of New York, Shaft 13, Katonah (Res., Kisco Gardens, Mt. Kisco), N.Y.

RAMSEIER, ROY EDWIN (Jun. '35; Assoc. M. '41), San. Engr., City of Richmond, City Hall, Richmond (Res., 2813 Parker St., Berkeley), Calif.

REDMILE, HAROLD FRANKLIN (Jun. '35; Assoc. M. '41), Asst. Const. Supt., E. I. du Pont de Nemours & Co., Inc. (Res., 206 Waitman St.), Morgantown, W.Va.

REID, KEITH CAMERON (Jun. '39; Assoc. M. '41), Engr., Pacific Naval Air Bases, 123 Dowsett Ave., Honolulu, Hawaii.

SHULTZ, ROBERT JOHN (Jun. '36; Assoc. M. '41), Asst. Engr., U.S. Engr. Dept., 751 South Figueroa St. (Res., 1179 West 37th Pl.), Los Angeles, Calif.

STEM, CLIFFORD HOEY (Jun. '17; Assoc. M. '20; M. '41), Pres. and Gen. Mgr., New Orleans Equipment Co., 400 Jackson Ave. (Res., 7933 Willow St.), New Orleans, La.

STEPHENSON, LOWELL JOSEPH (Jun. '29; Assoc. M. '31; M. '41), Lt., CEC-V (S), U.S.N.R., Asst. Public Works Officer, Marine Barracks, Quantico, Va.

REINSTATEMENTS

EVANS, WILLIAM HAROLD, Assoc. M., reinstated Sept. 3, 1941.

HURD, HAROLD WALLER, Assoc. M., reinstated Aug. 27, 1941.

MACKRELL, EDWIN ALLAN, M., reinstated Aug. 11, 1941.

MCCULLOMS, MAX REED, M., reinstated Aug. 12, 1941.

PACKMAN, IAN BUCHANAN, Assoc. M., reinstated Sept. 4, 1941.

PALMIERI, MARIO, Assoc. M., reinstated Sept. 2, 1941.

SIEMS, VALENTINE BERNARD, M., reinstated Sept. 2, 1941.

WATSON, RICHARD CHARLES SANCHEZ, Assoc. M., reinstated Sept. 4, 1941.

RESIGNATIONS

ROBERTS, LLOYD WILLIAM, Assoc. M., resigned Aug. 18, 1941.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

October 1, 1941 NUMBER 10

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for sub-professional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i. e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

BARBER, BRUCE PALMER, Columbia, S.C. (Age 39) (Claims RCA 2.0 RCM 8.4) Oct. 1937 to date Associate Mgr. and Partner, Tomlinson Eng. Co.; previously Prin. Engr., Ryan Eng. Co., Columbia, S.C.

BARTELS, WILLIAM RUDOLF, Honolulu, Hawaii. (Age 53) (Claims RCA 10.8 RCM 9.0) July 1932 to date Bridge Engr., Div. of Highways, Territorial Dept. of Public Works, Hawaii.

BERRIGAN, PAUL DUNN (Assoc. M.), Dallas, Tex. (Age 35) (Claims RCA 3.0 RCM 9.2) June 1927 to date with Corps of Engrs., U.S. Army, as 2d Lieut., 1st Lieut., Capt., and at present Major.

BOOTH, ARCHIBALD ALLAN KIRSCHNER (Assoc. M.), Charlotte, N.C. (Age 39) (Claims RCA 2.5 RCM 6.0) Nov. 1936 to date Structural Engr., Duke Power Co.; previously with National Park Service, ECW, as Senior Foreman, Project Supt., and Asst. Engr.

BRUNKOW, NORMAN FERDINAND, Oak Park, Ill. (Age 51) (Claims RCA 5.3 RCM 9.3) July 1941 to date Structural Engr., Graham, Anderson, Probst & White, Chicago, Ill.; previously Structural Engr. with Carl A. Metz & Co., Allen and Garcia, and Greeley and Hansen, all of Chicago, Ill., and others.

BUSHNELL, DONALD HENDERSON, Washington, D.C. (Age 37) (Claims RCA 1.5 RCM 13.7) Feb. 1934–Feb. 1935 Drainage Engr., Nov. 1935–Dec. 1938 Senior Hydr. Engr., Jan. to June 1939 Asst. Chf. Engr. Appraiser, and June 1939 to date Asst. Chf. of Appraisal Eng. Sec., FCA; in the interim (on leave of absence from FCA), Engr. Appraiser, Federal Land Bank of St. Paul, Minn.

CLAUS, FRED CHARLES (Assoc. M.), Trenton, N.J. (Age 50) (Claims RCA 15.7 RCM 13.0) April 1923 to date with New Jersey State Highway Dept., as Senior Draftsman, Res. Engr., and (since Feb. 1928) Res. Engr. and Location Engr.

DE LA CANTERA, FERNANDO, San Francisco, Calif. (Age 53) (Claims RCA 3.0 RCM 22.0) 1931 to date Engr. and Builder (private practice) designing, detailing, and constructing steel and concrete structures.

ENGLE, HAROLD MARSHALL, San Francisco, Calif. (Age 43) (Claims RCA 1.3 RCM 15.7) 1930 to date in private practice as Civ. and Structural Engr.; also Cons. Structural Engr., Board of Fire Underwriters of the Pacific.

EUSTROM, HARVEY HENRY, Burlington, Iowa. (Age 42) (Claims RCA 5.1 RCM 5.8) Capt., Q.M.C.; Nov. 1940 to date Chf. Engr. and Executive Officer in charge of construction at Iowa Ordnance Plant, Burlington, Iowa; previously with Michigan State CCC Field Organization.

Fletcher, Adam Gordon, Malvern, Victoria, Australia. (Age 52) (Claims RCA 7.3 RCM 14.8) July 1911 to date (except Jan. 1917 to Sept. 1919 with Australian Imperial Forces in World War) with Victorian Railways Commrs., as Asst. Engr., Engr., Dist. Engr., Dist. Supt., Supt., Asst. Gen. Supt. of Transportation, and (since March 1938) Chf. Civ. E-gr., Way and Works Branch.

Folk, Samuel Byron (Assoc. M.), Columbus, Ohio. (Age 43) (Claims RCA 8.0 RCM 7.2) Sept. 1926 to 1934 Asst. Prof., and 1934 to date Associate Prof., of Mechanics, Ohio State Univ.

Foster, Leo Joseph, Yuma, Ariz. (Age 58) (Claims RCA 7.5 RCM 21.4) Aug. 1904 to date with Bureau of Reclamation as Rodman, Chainman, Levelman, Transitman, Computer, Chf. of Field Party, Draftsman, Office Engr., Asst. to Chf. of Constr., Project Mgr., Investigating Engr., and (since Jan. 1935) Constr. Engr.

Gessner, Edward Heim (Assoc. M.), Alameda, Calif. (Age 35) (Claims RCA 1.0 RCM 10.8) July 1941 to date Lieut., CEC, U.S. Navy, as Asst. Officer in charge of Naval Air Station; previously Contr. Engr., Doullut & Ewin, Inc., Mobile, Ala.; Representative for Eastern Venezuela, Chicago Bridge & Iron Co., Elizabeth, N.J.; Gen. Supt., Martin Eng. Co., Maracaibo, Venezuela.

Gibbs, Frederick Scott, Boston, Mass. (Age 36) (Claims RC 12.2 D 12.2) Jan. 1930 to date with Wallace & Tiernan Co., Inc., on design and supervision of water-works and sewerage.

Harris, Arthur Raymond, Chicago, Ill. (Age 44) (Claims RCA 2.0 RCM 18.8) March 1923 to date with Bridge Dept., Chicago & Northwestern Ry. Co., as Draftsman, Designer, Asst. Chf. Draftsman, Office Engr., and (since Sept. 1941) Asst. Engr. of Bridges.

Hilp, Harry Henry, San Francisco, Calif. (Age 53) (Claims RCM 27.5) Oct. 1912 to date member of firm, Barrett & Hilp, Gen. Contrs.

Langfitt, Lyle Edgar, Charleston, W.Va. (Age 38) (Claims RCA 7.1 RCM 6.4) May 1934 to date Engr., Public Service Comm. of West Virginia.

Mason, John Leslie (Assoc. M.), Modesto, Calif. (Age 44) (Claims RCA 2.8 RCM 10.9) May 1933 to date in private practice, also since July 1938 Asst. City Engr.

Miller, Henry Stevenson (Assoc. M.), St. Louis, Mo. (Age 45) (Claims RCA 17.0 RCM 5.4) Dec. 1918 to April 1934 Jun. Engr. and Senior Civ. Engr., and July 1941 to date Senior Civ. Engr., Sewers and Paving Div., St. Louis (Mo.) Board of Public Service; in the interim Engr., Widmer Eng. Co.; Traveling Engr., PWA; with FEA of PW, as Res. Engr. Inspector, Relief Engr. Inspector, and Traveling Engr. Inspector.

Montgomery, James McKee, Los Angeles, Calif. (Age 44) (Claims RCA 4.8 RCM 11.7) At present in practice as J. M. Montgomery & Co., Engrs.; Oct. 1937 to Aug. 1941 member of firm, Hoover and Montgomery; previously Asst. Chf. Engr., The Permutit Co., New York City.

Noyes, John Rutherford (Assoc. M.), Mobile, Ala. (Age 39) (Claims RCA 4.0 RCM 5.8) Jan. 1924 to June 1925 and June 1926 to date with Corps of Engrs., U.S. Army as 2d Lieut., 1st Lieut., Capt., and (since Jan. 1941) Major, acting as Asst. to Dist. Engr.

Olsen, John Thorvelt, Greenwood, Miss. (Age 42) (Claims RCA 8.7 RCM 12.5) Feb. 1936 to date with SCS, U.S. Dept. of Agriculture, as Asst. Drainage Engr., Associate Drainage Engr., and (since Feb. 1940) Senior Drainage Engr.

Richardson, Rex Densmore (Assoc. M.), Scranton, Pa. (Age 58) (Claims RCA 2.0 RCM 32.0) Jan. 1916 to date Pres. and Gen. Mgr., R. D. Richardson Constr. Co., Engrs. and Contrs.

Rush, Alger Emanuel, Chattanooga, Tenn. (Age 42) (Claims RC 15.3 D 2.8) Sept. 1924 to date with Tennessee Highway Dept., as Jun. Engr., Res. Engr., etc., and (since Feb. 1935) Asst. Engr., Associate Engr. and Highway Engr.

Sheridan, Arthur Vincent (Assoc. M.), New York City. (Age 55) (Claims RCA 3.7 RCM 20.5) 1938 to date Commr. of City Planning, City of New York; previously with Bureau of Design, Dept. of Public Works, Office of Borough President, Bronx, as Asst. Engr., Engr. of Design, and Chf. Engr.

Strattman, Charles Robert (Assoc. M.), Jackson, Mich. (Age 53) (Claims RCA 10.9 RCM 11.5) Oct. 1920 to date with Michigan Central R.R. as Instrumentman, Asst. Engr., Supervisor of Track, and (since Oct. 1939) Div. Engr.

Studdert, William Walton (Assoc. M.), New River, N.C. (Age 38) (Claims RCA 7.9 RCM 7.0) May 1941 to date Lieut., CEC, Bureau of Yards and Docks, U.S. Navy Reserve; May 1937 to May 1941 Civ. Engr., Texas-New Mexico Pipe Line Co., Midland, Tex.; previously Associate Engr., Chf. of Surveys, U.S. Engr. Dept.

Sturgeon, Myron Alfred, Suffolk, Va. (Age 40) (Claims RCA 9.0 RCM 8.8) Dec. 1937 to Dec. 1940 and Sept. 1941 to date in private practice of contracting and engineering; in the interim (short periods) with various contractors, etc.

Styer, Wilhelm Delp, Washington, D.C. (Age 48) (Claims RCM 21.2) At present Lt. Col., Corps of Engrs., U.S. Army; Dec. 1940 to date Deputy Chf. and Executive Officer of Constr. Div., Office of Quartermaster General; May 1936 to July 1939 Asst. Engr. of Maintenance, The Panama Canal.

Tatlow, Richard Henry, III (Assoc. M.), Chevy Chase, Md. (Age 35) (Claims RCA 2.3 RCM 8.2) July 1940 to date Asst. Chf., Eng. Branch, Constr. Div., QMC, Washington, D.C.; previously with Harrington and Cortelyou, Cons. Engrs., Kansas City, Mo., and Washington, D.C., as Engr., Jun. Member, and Partner.

Turner, Robert Edwin, Conowingo, Md. (Age 40) (Claims RCA 4.1 RCM 15.0) 1926 to date with Philadelphia (Pa.) Elec. Co. and subsidiary companies as Asst. Investigator of Plant Tests, Tech. Asst. to Asst. Chf. Engr., Inspector, Investigator of Plant Tests, and past $5^1/_2$ years as Hydrographer.

Wheeler, Millard Franklin, Baltimore, Md. (Age 37) (Claims RCA 3.2 RCM 9.6) Dec. 1938 to date Structural Designer with Consolidated Gas, Elec. Light & Power Co.; June 1937 to Dec. 1938 Structural Engr. with W. W. Pagon, Cons. Engr.; previously Structural Engr. with Lucius R. White, Registered Archt.; Asst. Structural Engr., Q.M.C., War Dept., Washington, D.C.

APPLYING FOR ASSOCIATE MEMBER

Almy, Loren Billings, Grand Forks, N.Dak. (Age 32) (Claims RCA 1.5) Sept. 1939 to June 1940 Instructor in, and Sept. 1940 to date Asst. Prof. of, Civ. Eng., Univ. of North Dakota; June to Aug. 1940 Instrumentman, North Dakota Highway Dept.; previously Rodman and Instrumentman, Nebraska Dept. of Roads and Irrigation.

Anderson, Norman Carl, Seattle, Wash. (Age 50) (Claims RCA 6.8) Jan. 1928 to date with King County Engr.'s Office, as Draftsman, Chf. Draftsman, and (since April 1937) in charge of Right-of-Way, Franchise and Bldg. Dept., also Court Engr. for Office.

Baker, Barnet, Cleveland, Ohio. (Age 42) (Claims RCA 5.2 RCM 4.0) 1924 to date with City of Cleveland, Ohio, as Asst. Engr., etc., and (since 1935) Asst. and Senior Asst. Engr.

Barbee, Joseph Franklin (Junior), Columbus, Ohio. (Age 33) (Claims RCA 5.7 RCM 2.1) Aug. 1930 to date with Ohio State Highway Testing Laboratory, as Laboratory Asst. and Inspector, Asst. Engr., Engr. (Grade IV c and IV b), and (since July 1939) Engr. (Grade IV A and III C).

Bowmaster, Wylie Albert (Junior), Norris, Tenn. (Age 32) (Claims RCA 3.8) April 1934 to date with TVA, as Jun. Hydr. Engr., Asst. Hydr. Engr., and (since April 1940) Associate Hydr. Engr.

Burt, Gordon Lansing (Junior), Terre Haute, Ind. (Age 28) (Claims RCA 3.3) May 1941 to date Chf., Div. of Water and Sewer Utilities, Russ and Harrison, Archt.-Engr., Jefferson Proving Ground, Madison, Ind.; previously with Charles H. Hurd, Cons. Engr., Indianapolis, Ind., as Draftsman, Res. Engr., and Asst. Res. Engr. on various sewage-treatment and municipal water-works systems.

Chafe, Bruno (Junior), Plattsburg Barracks, N.Y. (Age 33) (Claims RCA 5.4 RCM 1.0) Dec. 1940 to date 2nd Lieut., Corps of Engrs., U.S. Army, at present with 36th Engrs.; June to Dec. 1940 Chf. of Party, Bureau of Eng., City of Binghamton; previously Asst. to W. F. Sherwood, Civ. Engr.; Asst. to Z. B. Phelps, Jr.

Corlett, Harry Beaumont, Oakland, Calif. (Age 46) (Claims RCA 7.7) Sept. 1940 to date Asst. Engr., Columbia Steel Co., San Francisco; previously Designer, Detailer, and Checker, Placer Management, Ltd.

Curtis, Oliver Benton, Sr., Jackson, Miss. (Age 38) (Claims RCA 4.7 RCM 2.7) Oct. 1932 to date with Mississippi State Highway Dept., Jackson, Miss., as Instrumentman, Project Engr., and (since May 1938) Asst. Mgr.

Dobbs, Melvin Arthur (Junior), East St. Louis, Ill. (Age 32) (Claims RCA 1.6 RCM 3.5) Feb. 1938 to date San. Engr., East Side Health Dist., East St. Louis, Ill.; previously Asst. San. Engr., Illinois State Dept. of Public Health, Springfield, Ill.

Dowling, Louis Earl, Jr. (Junior), Washington, D.C. (Age 32) (Claims RCA 4.9) June 1939 to date with Navy Dept., Bureau of Yards and Docks as Asst. Engr., and (since Jan. 1941) Associate Engr.; previously Designer, Pittsburgh (Pa.) Bureau of Eng., Div. of Bridges and Structures; Designer, Blaw-Knox Co., Blawnox, Pa.

Enger, Walter Melvin (Junior), Los Angeles Calif. (Age 27) (Claims RCA 3.2) June 1935 to Sept. 1941 with U.S. Bureau of Reclamation, as Jun. Engr. and Asst. Engr.; since Sept. 1941 Lt. (jg), U.S.N.R.

Everham, Arthur Thompson (Junior), Los Angeles, Calif. (Age 32) (Claims RCA 1.9 RCM 2.8) Feb. 1939 to date Partner and Western Mgr., Everham Foundation Co.; previously with Raymond Concrete Pile Co., as Layout Engr., and Asst. to Dist. Mgr.; Office Engr., Smith Bros. Constr. Corporation; Engr. and Draftsman, Spillway Bldrs., Inc., Ft. Peck, Mont.

Fitch, Lewis William, Muskegon Heights, Mich. (Age 36) (Claims RCA 5.0 RCM 4.0) Aug. 1933 to date Project Engr., Michigan State Highway Dept., being Res. Engr. in charge on road and bridge construction.

Gannon, Donald Arthur (Junior), Santa Maria, Calif. (Age 32) (Claims RCA 3.0) June 1941 to date Asst. Engr., Leeds, Hill, Barnard & Jewett, Cons. Engrs.; previously with SCS as Asst. Engr., Jun. Engr., and Associate Conservationist.

Glynn, Frederick Stanley, Jr. (Junior), Norfolk, Va. (Age 31) (Claims RCA 1.0) Sept. 1937 to date with Stone & Webster Eng. Corporation, as Testing Engr., and (at present) Constr. Engr.; March to June 1937 Testing Engr., Thompson & Lichtner Co., Inc.; previously with Franklin Constr. Co., Medford, Mass.; Contractor handling many small contracts.

Hunt, Theodore William (Junior), Binghamton, N.Y. (Age 32) (Claims RCA 4.0) March 1934 to date with U.S. Engr. Office, as Inspector, Topographic Draftsman, and (since Dec. 1939) Jun. Engr. (Civil).

Kellogg, Markoe Orcutt (Junior), Trinidad, B.W.I. (Age 31) (Claims RCA 2.8) At present Asst. Engr., U.S. Engr. Corps, Caribbean Div., Trinidad, B.W.I.; Feb. 1936 to Aug. 1941 with Sales Constr. Dept., Sun Oil Co., as General Laborer, Draftsman, and Field Engr.

Koy, Justus John (Junior), Houston, Tex. (Age 33) (Claims RCA 4.5) June 1930 to date with United Gas Pipe Line Co., as Chainman, Instrumentman, Clerk, and (since Aug. 1933) Engr.

Leonard, Charles Anthony, Rock Island, Ill. (Age 33) (Claims RCA 5.9) June 1931 to date with U.S. Engr. Office as Jun. Computer, Jun. Engr., Asst. Engr., Asst. and Associate Engr., etc., and (since Sept. 1940) Associate Engr. and Engr.

Lilley, Gordon Arthur (Junior), Ocean Beach, Calif. (Age 33) (Claims RCA 3.8) Feb. 1931 to date with U.S. Engr. Office as Surveyman, Jun. Engr., Asst. Engr., Associate Engr., and at present Engr.

Mair, Mehr Chand, Quetta, India. (Age 34) (Claims RCA 8.7 RCM 1.3) 1937 to date with Public Works Dept., Secretariat, Quetta, India, until 1940 as Structural Engr., and (since 1941) Sub-Divisional Officer; 1936 to 1937 Designer of earthquake-proof building for Engr. in Chf., Army Headquarters, Simla, India.

Meisterlin, Carl Sverre, Petersburg, Va. (Age 38) (Claims RCA 4.6) Sept. 1940 to date Structural Designer, The Solvay Process Co., Hopewell, Va.; Sept. 1938 to Sept. 1940 Structural Engr., Peden Steel Co., Raleigh, N.C.; previously Asst. Structural Engr., TVA, Knoxville, Tenn.

Miller, DeWolfe Hugo, Baltimore, Md. (Age 33) (Claims RCA 4.5 RCM 3.8) Nov. 1940 to date 1st Lieut., U.S. Army, Quartermaster Corps, Constr. Div.; previously Jun. Eng. Office, Aide, and Asst. Bridge Engr., Bridge Dept., California Div. of Highways.

NORMAN, VAN CRESAP, Sault Ste. Marie, Mich. (Age 35) (Claims RCA 3.5) At present Capt., 702d M.P. Br. (Z/I); Feb. 1930–Jan. 1941 Test Asst., Association of American Railroads.

SAYLOR, WILLIAM HENRY (Junior), Los Angeles, Calif. (Age 32) (Claims RCA 6.3 RCM 0.6) April 1938 to date with U.S. Engr. Dept., as Asst. Engr., Dam Design, and (since Feb. 1941) Associate Engr., Head Dam Design Group, Flood Control Design Sec.; previously with Metropolitan Water Dist. of Southern California, as Rodman, Instrumentman, and Jun. Engr.

SCHOFIELD, CALVIN ONDERDONK, Pembroke, Ga. (Age 37) (Claims RCA 5.7 RCM 1.2) Nov. 1937 to March 1940 Project Manager, and Dec. 1940 to date Chf. Engr., SCS; in the interim Field Engr., Delaware, Lackawanna & Western R.R., Syracuse, N.Y.; previously Project Engr., Land Utilization Div., U.S. Dept. of Agriculture.

SEABROOK, CHANCY SABINE, Tacoma, Wash. (Age 46) (Claims RCA 8.3 RCM 1.0) July 1938 to date Office Engr., Chf. Civ. Engr., Office of Constr. Quartermaster, Ft. Lewis, Wash.; previously taught mathematics and science, Chino (Calif.) Vocational High School; designer, Seaboard Eng. Co., Beverly Hills, Calif.; Office Engr., City of Richmond, Calif.

SHACK, STEPHEN GEORGE, Pittsburgh, Pa. (Age 31) (Claims RCA 2.7) Nov. 1940 to date Structural Engr., Constr. Div., Harbison-Walker Refractories Co.; previously Estimator, Draftsman, and Structural Engr., Keystone Eng. Co.

STRIEBER, ALTON LEROY, San Antonio, Tex. (Age 37) (Claims RC 9.0 D 1.7) At present Office Engr. with H. R. F. Helland; Nov. 1940 to July 1941 Constr. Engr., Helland and Drought; previously Asst. Civ. Engr., WPA; Inspector and Clerk-of-Works, Associated Housing Archts.; Res. Engr., Hawley, Freese and Nichols, and Freese and Nichols.

THOMASSON, EDWARD RAY, JR., Columbus, Miss. (Age 30) (Claims RCA 7.0 RCM 2.2) Oct. 1939 to date with U.S. Engrs., until Aug. 1941 at Washington (D.C.) National Airport, as Party Chf., etc., at present at Columbus, Miss., Office; previously Concrete Inspector, City of Columbia, S.C.; with WPA as Project Engr.; with U.S. Engr. Dept., as Party Chf.

WALKER, ARTHUR VALENTINE, Sacramento, Calif. (Age 41) (Claims RCA 12.8) Aug. 1933 to date Asst. Bridge Engr., Bridge Dept., California State Div. of Highways.

WILLIAMS, JOSEPH SANFORD, Baltimore, Md. (Age 42) (Claims RCA 19.0) Oct. 1929 to date Constr. Engr. and Supt., Ligon & Ligon.

APPLYING FOR JUNIOR

BODWELL, GEORGE BISHOP, Cleveland Height, Ohio. (Age 29) (Claims RCA 4.7) June 1935, to date with The Carey Co., Cleveland, Ohio, as Estimator, Sales Engr., Constr. Supt., Mgr., Contract Dept., and (since Aug. 1938) Sales Mgr.

COLEMAN, ROBERT FEASTER, JR., Raleigh, N.C. (Age 23) 1940 B.C.E., N.C. State Coll.; at present graduate student, North Carolina State Coll.

COOK, PAUL MEREDITH, Vancouver, B.C., Canada. (Age 24) Feb. 1941 to date Aircraft Inspector for Govt. of Canada; previously Draftsman with Granby Consolidated Mining, Smelting and Power Co., and The Welding Shop & Eng. Co.

GETZMAN, EDWIN MITTS, Sebastopol, Calif. (Age 29) (Claims RCA 1.2) May 1939 to date with SCS, U.S. Dept. of Agriculture, as Jun. Civ. Engr., Jun. Agri. Engr., at present reclassified as Civ. Engr.; previously Jun. Civ. Engr., Southern California Gas Co., Los Angeles, Calif.

HENDRICKSON, KARL NEWCOMB, Kittery, Maine. (Age 26) July 1941 to date Asst. Civ. Engr. (rank of Ensign), U.S. Navy, Portsmouth (N.H.) Navy Yard Public Works Office; previously Civ. Engr., Haller Eng. Associates, Inc.; Graduate Asst. in Civ. Eng., Univ. of Maine; Soil Mechanics Technician, Maine Highway Comm., Orono, Maine, etc.

HERR, JOSEPH, JR., New York City. (Age 31) (Claims RCA 3.5) July 1941 to date with The American Can Co., Eng. Dept., New York City, as Archt.-Engr.; June 1939 to July 1941 Archt.-Engr., The Austin Co., Engrs. & Bldrs.; previously with Sidney Schuman, Archt.

HOWARD, HARRY, JR., New York City. (Age 28) 1941 to date Engr., National Conservation Bureau; previously Engr., Traffic Eng. Div., South Carolina State Highway Dept.

JONES, CHARLES ALBERT, JR., Philadelphia, Pa. (Age 25) 1940 B.S., Drexel Inst. Tech.; Aug. 1940 to date 2d Lieut., U.S. Army, being Platoon Leader, Rifle Platoon.

NEUMANN, ERNEST LESLIE, Monroe, Mich. (Age 29) (Claims RCA 0.7) July 1941 to date Asst. City Engr.; previously with Michigan State Highway Dept., as Grade Inspector, Aggregate Inspector, and Testing Laboratory Aide.

ROSENTHAL, ROBERT WILLIAM, Ancon, Canal Zone. (Age 24) Aug. 1940 to date with Office Eng. Div., The Panama Canal, Balboa Heights, Canal Zone, as Student Engr. and Structural Designer, Pl; previously Student Engr., Minneapolis (Minn.) Gas Light Co.

SHANDLOFF, ARTHUR MORDECAI, Miami, Fla. (Age 24) (Claims RCA 1.5) May 1941 to date Eng. Aide, War Dept., Miami Beach Sub-office; April 1939 to March 1941 Asst. Secy., The Masterbilt Corporation, Miami Beach; previously Dredging Engr., M & M Dredging Co.; Instrumentman and Draftsman, Eng. Dept., City of Miami Beach.

TOWER, KENNETH GERALD, Portland, Ore. (Age 31) (Claims RCA 2.9 RCM 1.5) June 1939 to date Asst. Engr., War Dept., U.S.E.D.; previously Jun. Engr., Spillway and Concrete Dams Secs., U.S. Bureau of Reclamation, Denver, Colo.

WALKER, RONALD PAUL, Port of Spain, Trinidad, B.W.I. (Age 26) (Claims RCA 1.3) Dec. 1940 to date Asst. Engr., Planning and Housing Comm., Port of Spain, Trinidad; Dec. 1939–Nov. 1940 Party Leader and Instrumentman, Caribbean Constr. Co., Ltd.; previously Topographical Surveyor, United British Oilfields, Ltd., Trinidad.

WONG, ALFRED JACK QUON, Honolulu, Hawaii. (Age 23) May 1941 to date Jun. Civ. Engr., Office of Constr. Quartermaster, War Dept.; previously Project Draftsman and Plans and Material Clerk, Pacific Naval Air Bases.

1941 GRADUATES

ALA. POL. INST.
(B.S.C.E.)

	AGE
JONES, MILLARD HARRISON	(24)

UNIV. OF ARK.
(B.S.C.E.)

DUNKLE, WILLIAM FRANKLIN (22)

BUCKNELL UNIV.
(B.S. in C.E.)

REED, CHARLES PALMER (24)

CASE SCHOOL OF APPLIED SCI.
(B.S. in Civ. Eng.)

DEEMS, NYAL WILBERT (23)

CATHOLIC UNIV. OF AMERICA
(B. in Arch. Eng.)

CLAGETT, HUGH CALDWELL (25)
PRESTON, WINFIELD SCOTT, JR. (23)

CLARKSON COLL. TECH.
(B.C.E.)

THAYER, EDWIN SWEET (21)

UNIV. OF COLO.
(B.S. in A.E.)

HAGUE, HAROLD HOWES (22)
ISEMINGER, HAROLD FRANCIS (24)

(B.S. in C.E.)

BEABER, HOWARD CHARLES (22)

CORNELL UNIV.
(B.C.E.)

HOWE, WARNER (22)
LYNCH, HOWARD POYER (21)

DREXEL INST. TECH.
(B.S. in C.E.)

COBAUGH, LEON RODNEY (21)
EPSTEIN, OSCAR (26)
JACOBY, ROBERT GORDON (21)
KERBER, WILLIAM CONRAD, JR. (24)
MARTIN, LEONARD (24)
RENGEPES, FRANK GEORGE (22)
SUMMER, WALTER BASSETT (28)
VOGTLE, JOHN CARL (25)
WELLER, WILLIAM LEE (22)

UNIV. OF IDAHO
(B.S.C.E.)

SHADEL, FRANCIS HENRY (22)

UNIV. OF ILL.
(B.S. in Civ. Eng.)

PATHMAN, WILLIAM JAY (22)

THE JOHNS HOPKINS UNIV.
(B.C.E.)

BONNETT, GERSON (20)

UNIV. OF KY.
(B.S. in Civ. Eng.)

HORLANDER, FRED CLARK (24)

MARQUETTE UNIV.
(B.C.E.)

HOLCOMB, JOHN KENNETH (22)
WOLLIN, ERNST GEORGE (23)

MICH. STATE COLL.
(B.S. in C.E.)

LUHRS, ROBERT HENRY (23)
WEBB, JAMES ELLSWORTH (22)

UNIV. OF NEBR.
(M.S. in C.E.)

FRAENKEL, STEFAN JOSEF (23)
(Also 1940 B.S. in C.E.)

N.Y. UNIV.
(B.C.E.)

BUTRICO, FRANK ANTHONY (21)
KOHN, EDWIN STORCH (21)
LANDIN, ARTHUR DAVID (30)
TAPMAN, WALTER PANICH (25)
WOINICH, PETER (22)

N.C. STATE COLL.
(B.C.E.)

ANDREWS, JAMES WARD (22)

OHIO NORTHERN UNIV.
(B.S. in C.E.)

LYMAN, ROBERT JOSEPH (24)

OKLA. A. & M. COLL.
(B.S. in Civ. Eng.)

BAKER, WOODROW WILSON (24)
HARBERT, GENE WOODROW (25)

ORE. STATE COLL.
(B.S.)

JACOBY, GAINEY EDWARD (23)

PRINCETON UNIV.
(B.S. in C.E.)

KROME, JOHN ELLIOTT (21)

S.DAK. STATE COLL.
(B.S.)

JACOBSON, GEORGE LLOYD (23)

SO. METHODIST UNIV.
(B.S. in C.E.)

EHNEY, WARD LISK, JR. (24)
GOODSON, RAYMOND LYLE, JR. (22)
PULLY, ROBERT VINSON (29)

UNIV. OF TENN.
(M.S. in C.E.)

PERNA, FRANCIS JOHN (23)
(Also 1940 B.C.E., Clemson Coll.)

UNIV. OF TEX.
(B.S. in C.E.)

DAVIS, HILTON KUNZE (25)
HUNTER, WILLIAM RANDOLPH (30)
WEISS, AUGUST LOUIS (22)
WILKES, WALTER JACKSON (22)

UNIV. OF UTAH
(B.S.)

HACKEN, NEPHI RUDOLPH (28)

UNIV. OF VA.
(B.S. in Civ. Eng.)

KJELLSTROM, NILS DAVID (21)

STATE COLL. OF WASH.
(B.S. in Civ. Eng.)

SARGENT, HAROLD VERNON (22)

UNIV. OF WASH.
(B.S. in Civ. Eng.)

WHITACRE, HORACE J., JR. (24)

UNIV. OF WIS.
(M.S. in Civ. Eng.)

COYNE, JOHN CHARLES (21)
(Also 1940 B.S. in Civ. Eng., La. State Univ.)

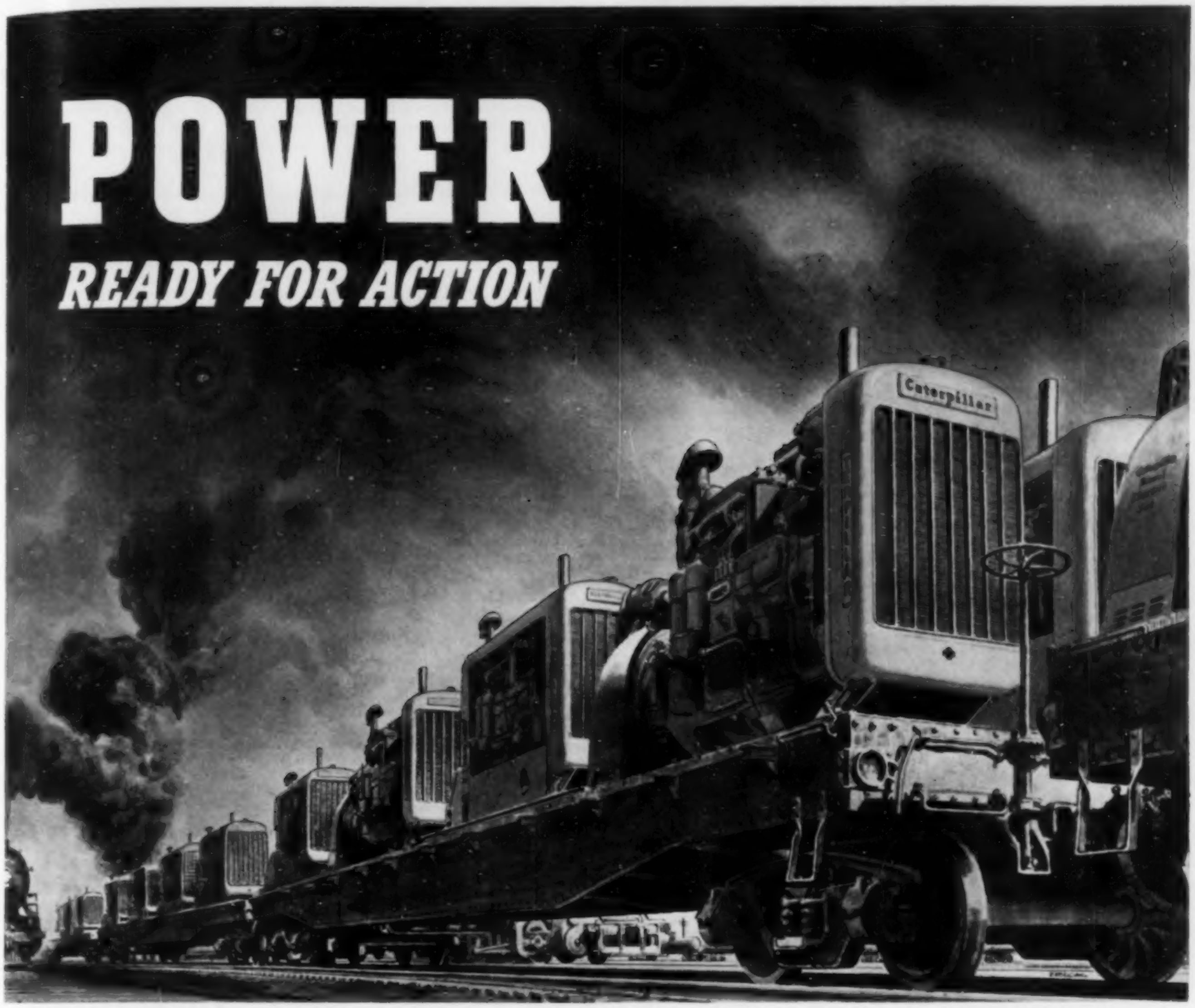
(B.S. in Civ. Eng.)

BROWN, EDWIN CHARLES (22)
FAULKES, WILLIAM FREDERICK, JR. (22)
HOGENSEN, ROBERT CHARLES (21)
ITZKOWITZ, NATHAN (22)

UNIV. OF WYO.
(B.S. in C.E.)

ENDICOTT, CLINTON LEROY (28)

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.



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ENGINES AND ELECTRIC SETS

Men and Positions Available

These items are from information furnished by the Engineering Societies Personnel Service, with offices in Chicago, Detroit, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 141 of the 1941 Year Book of the Society. To expedite publication, notices of positions available should be sent direct to the Personnel Service, 31 West 39th Street, New York, N.Y. Employers and applicants should address replies to the key number, care of the New York Office, unless the word Chicago, Detroit, or San Francisco follows the key number, when it should be sent to the office designated.

Construction

Construction Engineer; Jun. Am. Soc. C.E.; 31; married; graduate C.E.; registered; 6 years varied construction experience (roads, streets, sewers, water supply, buildings); 2 years geodetic surveying; 1 year of general design; now employed checking bridge and building structural design; desires permanent position. Available on 2 weeks' notice. C-871.

Executive

Executive Engineer; M. Am. Soc. C.E.; Mem. A.S.M.E.; 41; married; employed; experience in design and construction of petroleum refineries, piping, tankage, mill buildings, powerhouses, railroads, harbor works, housing; also operation of large refineries, powerhouse, repair shops; village management. Have handled 2,000 men and $10,000,000 construction in one year. Manage personnel well. Registered structural engineer, Illinois. C-873.

Structural

Structural Engineer and Draftsman; M. Am. Soc. C.E.; experienced on buildings, bridges, rolling mill construction, reinforced concrete, and general engineering work. Completing the work now as designing engineer for a large addition to a rolling mill. Available in 10 days. C-872.

Structural Engineer; M. Am. Soc. C.E.; graduate civil engineer; now employed; 6 years' European experience and 17 years' American experience in design, detailing, estimating, and construction of steel and concrete structures. Wishes permanent position. C-874.

Graduate Structural Engineer; M. Am. Soc. C.E.; New York License; 12 years' experience in structural and architectural design; 5 years' research in building materials and prefabrication of dwellings; at present in charge of structural design and estimating; desires connection with company engaged in prefabrication; available on month's notice; New York City preferred. C-875.

Miscellaneous

Chief Engineer, Industrial Corporation; Assoc. M. Am. Soc. C.E.; A.S.T.M.; A.C.E.; married; 42; desires administrative position in East; C.E. graduate, Rensselaer Polytechnic Institute; registered engineer, New York; 20 years' experience in structural engineering and research, development and practical application building materials of all kinds; broad knowledge of technical requirements of modern housing; seeks opportunity with progressive concern developing building products. C-876.

Positions Available

District Sales Manager, 35–45, experienced in the sale of fabricated steel. Apply by letter of application only. Location, East. Y-8327.

Estimators who have had considerable experience in estimating chemical plant construction and equipment. Must be qualified to assume responsibility. Salary, $4,000 a year. Location, New York, N.Y. Y-8370.

Structural Designers and Draftsmen who have had a good background of reinforced concrete and steel. Must be citizens of the United States. Salary, $2,700–$3,380 a year. Duration, 18 to 24 months. Location, New York Metropolitan Area. Y-8435.

Associate Inspectors of Construction, graduate engineers with a year or two of experience in construction field on buildings or, if not graduates, with 4 to 5 years' experience as a contractor's estimator or assistant on building construction. Duration, possibly 2 years. Will work on construction of temporary barracks, mess halls, timber buildings, and waterfront structures. Salary, $2,000 a year. Location, South. Y-8867.

Construction Engineers who have had experience in highways, drainage, small industrial buildings for airport construction in South America. Must speak Spanish and be a United States or British citizen. Y-8887.

Civil Engineer who has had at least 5 years' experience on topographical and hydrologic surveying and mapping. Salary, $3,600–$4,400 a year. Temporary. Location, foreign. Y-8896.

Chief of Party and Transitman to run layouts and line and grade for construction project. Temporary. Salary open. Location, South America. Y-8901.

Recent Graduate Civil Engineer to act as rodman on construction job. Salary, $2,080 a year. Location, New York State. Y-8919.

Construction Engineers: (1) Engineers who have been in charge of survey parties on project layouts. (2) Transitmen. (3) Plotters. (4) Estimators. Duration, one year. Salaries, $2,600–$3,900 a year. Location, foreign. Y-8920.

Maintenance Engineer, 30–45, either graduate mechanical or civil engineer, who has had some construction and alteration experience. Must be able to do some drafting, estimating, purchasing, and supervising erection. Permanent. Salary, $2,000–$3,000 a year. Location, New York, N.Y. Y-8927.

Engineers with training and experience in civil engineering or architecture with particular emphasis on construction. Salary open. Location, South. Y-8929.

Structural Engineer, not over 40, with experience in concrete design and who has had some experience in the design and construction of sewage and water plants, etc. Must have had considerable experience and a first-class record. Location, Middle West. Y-8930.

Engineers—two or three—who are qualified for design work on sanitary and storm sewers, water works, and water distribution systems. Will work on the preparation of detail construction plans on some large defense projects. Location, South. Y-8937.

Office Engineer, graduate civil engineer preferred, to work in office of a construction company. Must be able to take off quantities from prints and make estimates. Permanent. Salary, $2,600 a year. Location, New Jersey. Y-8942.

Hydraulic Engineers who have a complete knowledge of the design, construction, and inspection of hydraulic structures, such as dams, spillways, retaining walls, river and harbor improvements, etc. Salary, $3,800 a year. Location, California. Y-8945.

Designers who have had some good experience in the design of sewers. Must understand fluid flow and strength factors involved. Engineer who has worked for a private contractor, preferred. Salary, $4,200 a year. Location, New York, N.Y. Y-8960.

Topographical Draftsman. Must be very good letterer capable of making necessary mathematical calculations and preparing maps from field notes. Should also have had two years' pre-engineering, and five years' experience in topographic drafting. Should be single and able to speak Spanish. Employment is on basis of 2 years at a time, after which employee is entitled to 6 weeks' vacation in the United States. In the years in which long vacation is not taken, employee is entitled to 6 weeks' local leave. Personal expenses paid by the applicant but traveling expenses will be assumed by the company. Must pass physical examination. Salary, $4,740 a year in United States currency. Location, South America. Y-8965-A.

Civil Engineer, 1940–1941 graduate, who can produce good college transcript; must be single and expect to stay on job for 3 years. Will take about one year's training with production company in Southwest and then be transferred to South America. Salary, while in training, $1,800 a year; when in South America, $3,900 a year, minus $1,500 a year for board, room, and laundry. Will accrue 6-weeks' vacation in the United States, every 2 years, with company assuming passport and traveling expenses; in alternate years, two weeks' local leave. Y-8965-F.

Designer, 27–45, for the structural design of hydroelectric plants. An engineer who has had steam plant work would possibly qualify. Will consider man if he has had at least one year of good structural experience with a construction company specializing in power plant work. Salary, $2,100–$3,000 a year. Location, New York, N.Y. Y-8966.

Draftsman, graduate civil engineer, for the relocation of the main line and yards of a railroad. Must know standard curve and spur layout. Permanent. Salary, $4,000–$4,500 a year. Location, Pennsylvania. Y-8968.

Designing Engineer who is capable of laying out and designing all work in connection with a plant for the production of aluminum. Location, West. Y-8976.

RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room, will be found listed here. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

Design of Modern Steel Structures. By L. E. Grinter. Macmillan Co., New York, 1941. 452 pp., illus., diagrs., charts, tables, $9\frac{1}{2} \times 6$ in., cloth, $5.

This book and the first volume of the author's *Theory of Modern Steel Structures* are intended to furnish the requisite material for undergraduate courses in statically determinate structures. A somewhat novel arrangement presents, first, the chapters on riveted, welded, and other connections. Then follow chapters on tension and compression members, beams and girders, and stress determinations. Design procedures for roofs, truss bridges, buildings, and continuous beams end the book, except for a section giving abbreviated specifications issued by various engineering associations.

Flow of Water in Pipes and Pipe Fittings. By John R. Freeman. Published by the American Society of Mechanical Engineers (29 West 39th Street), New York City, 1941. 350 pp., illus., tables, diagrs., charts, $11\frac{1}{2} \times 9$ in., leather, $8.

Although the experiments described in this book were made in the nineties, the results are applicable to present-day pipe and fittings. All field notes from Dr. Freeman's original data books have been rechecked and the experiments worked out to conclusion, using modern methods of correlation instead of plotting friction factors against velocity only, as was customary at the time the experiments were made. The results of the experiments are compared with more recent experiments and discussed in the light of recent developments and analysis.

Mining Engineers' Handbook, 2 Vols., 3 ed. By R. Peele, with the collaboration of J. A. Church. John Wiley & Sons, New York, 1941. Paged in sections, diagrs., charts, tables, $9 \times 5\frac{1}{2}$ in., leather, $15.

The long-awaited new edition of Peele's Mining Engineers' Handbook appears in two volumes, owing to the great expansion of the work. The extensive revision throughout the text includes new sections on petroleum production and geophysical prospecting, and much information concerning new methods and devices in mining practice. The comprehensive character of the book is retained and is evidenced by the large amount of useful data on machinery, power plant, electric transmission, structural design, and metallurgy, for which the mining engineer often has need. A bibliography accompanies each section, and both volumes contain the complete index.

Sixty-Year Index A. S. M. E., 1880–1939. Published by the American Society of Mechanical Engineers (29 West 39th Street), New York City, 1941. 200 pp., $11\frac{1}{2} \times 8\frac{1}{2}$ in., cloth, $3.75.

Ten thousand items are required to cover adequately all the technical papers published in *Transactions* from 1880 to 1939, and in *Mechanical Engineering* from 1908 to 1939. These items are chronologically arranged under 768 subject headings, with each article listed under as many subject headings as are required. To direct attention to related articles, 700 cross-references have been used. An author index gives the subject headings and year under which each author's paper is listed in the subject index.

CURRENT PERIODICAL LITERATURE

Abstracts of Articles on Civil Engineering Subjects from Publications (Except Those of the American Society of Civil Engineers) in This Country and Foreign Lands

Selected items for the current Civil Engineering Group of the Engineering Index Service, 29 West 39th Street, New York, N.Y. Every article indexed is on file in The Engineering Societies Library, one of the leading technical libraries of the world. Some 2,000 technical publications from 40 countries in 20 languages are received by the Library and are read, abstracted, and indexed by trained engineers. With the information given in the items which follow, you may obtain the article from your own file, from your local library, or direct from the publisher. Photoprints will be supplied by this library at the cost of reproduction, 25 cents per page to members of the Founder Societies (30 cents to all others), plus postage, or technical translations of the complete text may be obtained at cost.

BRIDGES

RAILROADS, RELOCATION. Thirty-Mile Railroad Relocation at Shasta Dam, R. A. Midthun. *Reclamation Era*, vol. 31, no. 3, Mar. 1941, pp. 53–56 and 59. Comparative discussion of alternative routes for relocation of Southern Pacific Railroad line at Shasta Dam in California; railroad relocation construction procedure; earthwork; construction of 12 tunnels, ranging in length from 745 to 2,715 ft, and 8 bridges having combined length of nearly $2^1/_2$ miles.

STEEL GIRDER, CONTINUOUS. Continuous Steel Girder Bridge Rigidly Connected to Pier Tops, L. Hollister. *Eng. News-Rec.*, vol. 127, no. 3, July 17, 1941, p. 106. Design of Smith River highway bridge in northern California, having four main spans (two of 180 ft at center and one of 150 ft at each end), considering piers to be hinged at bottom and rigidly attached to girders at top.

STEEL TRUSS, BROOKLYN, N.Y. Design and Construction of Kosciusko (Meeker Avenue) Bridge, H. R. Seely. *Mun. Engrs. J.*, vol. 27, 1st Quarterly issue 1941, pp. 18–35 and (discussion) 35–38. Design and construction of new Meeker Avenue steel truss highway bridge over Newtown Creek, Brooklyn, N.Y., having total length of 6,415 ft, 3,223 ft of which is viaduct, and remaining 3,192 ft concrete ramps; construction of piers and foundations; total cost nearly \$6,000,000.

SUSPENSION, DESIGN. Zur Allgemeinen Formaenderungstheorie der verankerten Haengebruecke, F. Stussi. *Schweizerische Bauzeitung*, vol. 117, nos. 1 and 2, Jan. 4, 1941, pp. 1–4, and Jan. 11, pp. 18–22. Mathematical discussion of general theory of deformation of anchored suspension bridges, involving use of influence lines and "recursion" formulas; analysis of case of variable moment of inertia; numerical examples.

WOODEN. Montana Uses Creosote Treated Timber, B. J. Ornburn. *Pac. Bldr. & Engr.*, vol. 47, no. 3, Mar. 1941, pp. 46–48. Report on use of creosoted timber by Montana State Highway Department for construction of highway bridges; details of ice breakers for timber bents; details of composite concrete and timber trestles.

BUILDINGS

ACOUSTICS, THEATERS. Theatre Acoustic Recommendations Prepared by Academy Research Council Theatre Sound Standardization Committee. *Academy Motion Picture Arts & Sciences—Tech. Bul.*, May 31, 1941, 16 pp. Discussion of requirements for proper listening conditions as follows: size of room, shape of room, absorption characteristics of acoustic materials and their placement in room, and extraneous noise level present in room.

ANTI-AIRCRAFT PROTECTION. Measures of Defense Against Aerial Attack. *Am. City*, vol. 56, no. 7, July 1941, pp. 85, 87, and 103. Excerpts from U.S. War Dept. Bul. No. 1 on "Civilian Defense Protective Construction," covering sections on protection of buildings and of utilities and industrial plants.

AUDITORIUMS, ACOUSTICS. Development and Current Uses of Acoustic Envelope, H. Burris-Meyer. *Soc. Motion Picture Engrs.—J.*, vol. 37, July 1941, pp. 109–114. Technique is described by which acoustic conditions surrounding singers and instrumentalists during performance may be made to approximate those of highly reverberant studio irrespective of normal acoustic characteristics of theater, stage, or studio in which performance takes place.

HOUSING. Public Housing as Seen by Former Chamber of Commerce Manager, J. T. Daniels. *Am. City*, vol. 56, no. 8, Aug. 1941, pp. 48–50. Discussion of pros and cons of public housing; benefits from public housing to taxpayers and private business; attacking causes of blight and slums.

STEEL, WELDED. Welding of New Government Buildings, Stout Street, Washington, R. G. Colvin. *Welding J.*, vol. 20, no. 7, July 1941, pp. 443–447. Paper deals with practical side in welding of typical connections, as set out in engineering drawings and specifications supplied to contractor, Messrs. Cable and Company of Wellington; scope of paper is divided into two sections—typical beam-to-column connection and typical column splice connection; these sections are subdivided into shop welding and field welding. Before New Zealand Inst. Welding.

STRUCTURES, BOMBING EFFECT. Air Attack vs. Steel Structures, O. Bondy. *Iron Age*, vol. 148, no. 7, Aug. 14, 1941, pp. 42–45. Recent experience with various types of frame buildings in England illustrated and described.

CITY AND REGIONAL PLANNING

GREAT BRITAIN. Aspects of Reconstruction—I and II. *Nature* (London), vol. 147, nos. 3727 and 3728, Apr. 5, 1941, pp. 395–397, and Apr. 12, pp. 425–427. Discussion of British post-war reconstruction; object will be to find practical solutions for immediate problems of transition from war to peace, and to outline and amplify policy for years immediately following war; special committee of Town Planning Institute has been investigating problem of compensation and betterment in relation to town planning.

MODELS. Model for City Planning, W. A. Ridings. *Eng. News-Rec.*, vol. 127, no. 3, July 17, 1941, pp. 107–108. Construction of scale model of metropolitan district of Los Angeles, Calif., which has become one of most important "tools" in planning work.

PENNSYLVANIA. Planning for Future of Harrisburg Area. Report of Harrisburg Area Regional Planning Committee of Municipal League of Harrisburg, Pa., M. H. Dill and E. S. Draper. Harrisburg (Pa.) Municipal League, 1939–1940, 128 pp., figs., diagrs., tables. \$1. Analysis of planning factors and problems in area of Harrisburg, Pa.; geography of area; planning problems and suggestions; recommendations for larger metropolitan area; population growth trends; recommendations for inner city and for suburban fringe; metropolitan problems; land use map of Harrisburg area.

SOVIET UNION. Development of City Planning in Soviet Union, A. Ivanitsky. *Am. City*, vol. 56, no. 8, Aug. 1941, pp. 44–46 and 81. Review of development in city planning in U.S.S.R. since 1918; legislative framework; principal regional and city planning organizations of U.S.S.R.; characteristics of U.S.S.R. planning policy; neighborly units.

CONCRETE

AGGREGATES, STANDARDS. Selection of Aggregates for Concrete, A. H. Gawith. *Commonwealth Engr.*, vol. 28, no. 11, June 2, 1941, pp. 333–336. Recommendations for selecting suitable grading and tolerances; effect of maximum size of aggregate on efficiency of cement in concrete; standard "ideal" grading curve for fine aggregates.

CRACKING. Le Probleme de la fissuration du beton et l'emploi des aciers à haute limite élastique, G. Magnel. *Annales des Travaux Publics de Belgique*, vol. 41, no. 5, Oct. 1940, pp. 589–647 and (discussion) 648–659. Theoretical discussion of problems of cracking of concrete and effect of steel reinforcement of high elastic limit on cracking; cracking of concrete members pre-stressed by various means; effect of shear in concrete on tension in reinforcement. (In French and Flemish.)

DESIGN. Der auf Zug beanspruchte Eisenbeton, J. Baechtold. *Schweizerische Bauzeitung*, vol. 117, no. 3, Jan. 18, 1941, p. 27–30. Principles of design, including results of tests of reinforced concrete tension members, such as trusses, suspenders, braces, etc.

READY MIXED. Discrepancies Between Volume of Fresh Concrete at Ready-Mix Plant and Volume in Final Placement, H. J. Knopel. *Am. Concrete Inst—J.*, vol. 12, no. 6, June 1941, pp. 649–655. Discussion of problems arising in production and delivery of ready-mixed concrete; absolute volume method for deducing resulting yield of wet mixes by evaporation losses, by densification due to agitation, and by bleeding through forms or subgrades; errors from inaccurate forms; effect of aggregate subsidence; tests of water requirements; policies regarding over-sanding, excess water, and vibrated concrete.

REINFORCEMENT. Construction Design Chart—LXVI—Beam Reinforcing Steel Details, J. R. Griffith. *Western Construction News*, vol. 16, no. 6, June 1941, p. 176. Construction of alinement chart for design of details of reinforced steel of concrete beams; numerical examples.

ROADS AND STREETS. Construction of Concrete Roads, B. L. Wright. *Roads & Road Construction*, vol. 19, no. 221, May 1, 1941, pp. 80–82. Description of English practice in concrete road construction, with special reference to subgrade treatment and drainage. Before Instn. Highway Engrs.

ROADS AND STREETS. Placing and Finishing Pavement Concrete, H. F. Clemmer. *Am. Concrete Inst.—J.*, vol. 12, no. 6, June 1941, pp. 657–664. Discussion of possibilities of increased speed and performance in concrete highway construction through use of larger equipment, emphasizing coordination of machinery for increased output in all operations.

STANDARDS. How Durable Is Rapid-Hardening Concrete? *Indus. Standardisation*, vol. 12, no. 8, Aug. 1941, pp. 203–205. Recent trends in specifications for portland cement are reviewed; specifications for cement may need revision, author indicates, as result of studies now being made on concrete durability and effect on durability of minor constituents in cement. Before Am. Soc. Civ. Engrs.

CONSTRUCTION INDUSTRY

CONCRETE ARCH, CALIFORNIA. Second Debris Dam Completed. *Western Construction News*, vol. 16, no. 6, June 1941, pp. 170–172. Construction of Upper Narrows debris control dam, located on Yuba River about 25 miles northeast of Marysville, Calif., of constant angle arch design, with maximum height above bedrock of 281 ft and total crest length of 1,142 ft; aggregate plant; concreting methods.

CONCRETE GRAVITY, OREGON. Bonneville Dam on Columbia River, Oregon, U.S.A. *Engineering*, vol. 151, nos. 3927 and 3929, Apr. 18, 1941, pp. 301–303, 310, and May 2, pp. 341–344 and 350, supp. plates. Illustrated description, preceded by account of general configuration of Columbia River; spillway dam is gravity structure carrying series of reinforced concrete piers 10 ft thick; total length of dam 1,090 ft; 18 gates.

CONCRETE GRAVITY, WASHINGTON. Power Comes from Grand Coulee, D. L. Pratt. *Western Machy. & Steel World*, vol. 32, no. 5, May 1941, pp. 214–216. Notes on world's greatest masonry dam and its equipment; it is 550 ft high, 3,000 ft wide, 500 ft thick at base, 30 ft thick and 4,300 ft long at crest; equipped with eighteen 108,000-kva generators, three 10,000-kva station service units, 12 pumps each driven by 65,000-hp motor, and 18 turbines of 150,000 hp each.

RESERVOIRS, SILT. Removing Reservoir Silt by Sluicing Operations. *Eng. News-Rec.*, vol. 127, no. 1, July 3, 1941, p. 20. Description of sluicing operations for removal of silt from Upper San Fernando Reservoir of water works of Los Angeles, Calif., whose storage capacity was reduced (after 20 years of service) from 1,977 acre-ft to about 1,500 acre-ft.

WATER-PIPE INSTALLATION...

and how important savings can be effected with this modern pipe and coupling

TIME, labor and other installation expense make up a major part of the original cost of any water line. Therefore, for maximum economy the pipe specified must be designed for easy handling and rapid assembly under a wide variety of installation conditions. In Transite, more and more engineers are finding a water pipe that meets these requirements exactly.

Importance of light weight

Made of asbestos and cement, Transite is relatively light in weight—handling costs stay low. Smaller trucks may be used to transport pipe to the job and more linear feet may be carried at every trip. At the trench, crews find it easy and convenient to handle. All but the very largest sizes can be easily installed by hand without the use of mechanical equipment.

Simpler, more rapid assembly

Another important factor in reducing installation costs is the Simplex Coupling, employed in assembling Transite. Consisting of a Transite sleeve and two rubber rings, it is actually a pre-fabricated, *packaged* joint. Joints are assembled cold, without pouring, calking or heating equipment. A simple coupling puller (loaned without charge by Johns-Manville) is the only tool required. The operation is so simple that tight joints can be formed quickly and economically even by unskilled crews. Because no large bell holes are needed at joints, trenches can be narrower, less expensive. And wet trenches do not hold up installation, for the Simplex Couplings can be assembled whether the trench is wet or dry.

● Because of its light weight, Transite Pipe permits more footage to be carried at every truckload; a smaller truck may be used; and fewer men are required for every handling operation—thus reducing installation costs.

Other installation economies

When short lengths of pipe are required, Transite may be readily cut in the field with an ordinary hand saw. Connections to fittings are made easily and quickly by standard methods. Corporation stops and valves may be cut directly into the line while the main is under pressure. The deep, sharp threads it is possible to make in Transite assure perfect seating for such connections. And because of the unusual flexibility of the Simplex Coupling, wide sweeps can be made with straight lengths of pipe, without special fittings.

● Simplex Couplings are easily and quickly pulled into place with a simple coupling puller. The absence of hot-poured jointing materials eliminates the necessity of maintaining heating equipment at the trench and permits unskilled workmen to form tight joints quickly and economically.

... additional economies in service

In hundreds of American municipalities, Transite is helping to bring other water-carrying problems under control. Because of its smooth interior surface, Transite Pipe has an exceptionally high flow coefficient, Williams-Hazen C=140, and a correspondingly high delivery capacity. Because of Transite's asbestos-cement composition, this high figure can never be reduced by tuberculation. No allowances need be made for decreases in carrying capacity due to this internal corrosion. And maintenance costs stay low, for Transite is uniformly strong and durable, immune to electrolysis, and highly resistant to the corrosive action of both acid and alkaline soils. As a result, Transite assures long life and efficient, economical service wherever used.

● Transite may be tapped easily and rapidly with standard tools. And because no large bell holes are needed at joints, narrow, less expensive trenches may be used, with a resulting decrease of damage to pavements.

NOTE TO ENGINEERS: A fuller description of the many features of Transite Pipe that contribute to installation savings is given in the Transite Pipe brochure, TR-11A. A copy will be sent on request. Johns-Manville, 22 East 40th Street, New York, N. Y.

Johns-Manville TRANSITE PIPE

For efficient, economical water and sewer lines

DAMS

CONCRETE GRAVITY, AUSTRALIA. Woronora Dam. *Commonwealth Engr.*, vol. 28, no. 10, May 1, 1941, pp. 289–290. Report on current construction of Woronora curved concrete-gravity dam, 1,300 ft long, 217 ft high, having cutoff trench of 53 ft maximum depth, intended to increase water supply of Sydney, Australia.

CONCRETE GRAVITY, CALIFORNIA. Concrete Materials for Friant Dam, J. J. Waddell. *Reclamation Era*, vol. 31, no. 3, Mar. 1941, pp. 66–69. Selection and processing of aggregates for concrete placing in Friant Dam, Fresno, Calif.; screening and washing; pumicite and cement; transportation to dam.

CONCRETE GRAVITY, MONTANA. Broadwater-Missouri Diversion Project, F. E. Buck. *Pac. Bldr. & Engr.*, vol. 47, no. 2, Feb. 1941, pp. 34–37. Construction of concrete-gravity overflow dam, 750 ft long, about 40 ft high, on Upper Missouri River near Toston, Mont., which diverts water through system of canals to irrigate 21,000 acres of land; pressure grouting; canal headworks; overhead pipe line; equipment used.

CONCRETE GRAVITY, WASHINGTON. Concrete for Grand Coulee Dam, O. D. Dike. *Reclamation Era*, vol. 31, no. 3, Mar. 1941, pp. 57–59. Report on concrete placing for construction of Grand Coulee Dam; description of contractor's mixing plant; Bureau of Reclamation mixing plant inspection.

CONCRETE GRAVITY, WASHINGTON. Grand Coulee Dam. *Engineering*, vol. 151, nos. 3930, 3932, 3934, 3936, and 3937, May 9, 1941, pp. 361–362; May 23, pp. 401–402, and 410; June 6, pp. 441–443, and 450; June 20, pp. 481–484, and 490; and June 27, pp. 504–505, and 510; supp. plates. Detailed illustrated description. See also Engineering Index 1939, p. 299, and Engineering Index 1940, p. 304.

LANGDON, N.D. Coulee Beds Used for Reservoir, E. J. Franta and A. C. Mukomela. *Water Works Eng.*, vol. 94, no. 16, July 30, 1941, pp. 942–944. Description of water works system of Langdon, N.D., serving population of 1,500, featuring storage reservoirs that utilize natural coulee bed 240 ft wide, 16 ft deep.

RESERVOIRS, SILT. Silt Takes Heavy Storage Toll, C. B. Brown. *Water Works Eng.*, vol. 94, no. 15, July 16, 1941, pp. 874–877 and 908–909. Review of recent studies of silting in storage reservoirs, leading to conclusion that storage capacity lost by silting will destroy, in 50 years, one-third of water-supply reservoirs of United States; reservoir silting in South Carolina and Ohio; trees planted to check erosion; outstanding examples of silting; storage losses in California reservoirs.

FLOOD CONTROL

TEXAS. Texas Flood Takes Out Dam and Inundates Wide Areas. *Eng. News-Rec.*, vol. 126, no. 25, June 19, 1941, p. 926. Preliminary data on devastating floods of June 6 and 7 in Texas and New Mexico, due to rainfall which rated 8.6 in. in 9 hours at Austin, Tex.; destruction of Lake Diller Dam (near Albany, Tex.), 32 ft high.

FOUNDATIONS

DRYDOCKS, CALIFORNIA. Wellpoints Unwater Drydock Site to El.-45. *Eng. News-Rec.*, vol. 127, no. 1, July 3, 1941, pp. 75–76. Substitution of system of wellpoints for cofferdam, put down in three successive stages with risers 21 ft long in connection with construction of cruiser graving dock for U.S. Navy at San Diego, Calif.; 400,000 cu yd being excavated in dry to depth 45 ft below water level in adjoining bay.

FOOTINGS. Cantilever and Combined Footing Designs Compared, H. S. Woodward. *Eng. News-Rec.*, vol. 126, no. 25, June 19, 1941, pp. 950–951. Comparative discussion of economics of design of cantilever and combined footings for foundations; effect of length of span and distance between columns; design of straps for cantilever footings.

HYDRAULIC ENGINEERING

RESEARCH. Current Hydraulic Laboratory Research in United States. *U.S. Bur. Standards—Hydraulic Laboratory—Bul.*, no. 9, Jan. 1941, 157 pp. Information compiled with cooperation of various hydraulic and hydrologic laboratories in United States; bulletins give summary of hydraulic laboratory research in progress and also brief description of hydraulic laboratories in the United States and their experimental equipment.

HYDROLOGY AND METEOROLOGY

CENTRAL GREAT PLAINS. Watershed and Hydrologic Studies on Central Great Plains, J. A. Allis and L. L. Kelly. *Agric. Eng.*, vol. 22, no. 6, June 1941, pp. 215–217. Report on intensive study of hydrology of Beaver Creek watershed, 5,300 acres in area, located 25 miles south of Hastings, Nebr., for determination of effect of land use upon runoff and erosion; effect of intensity of grazing and contour furrows on runoff from pasture land; characteristics of flood runoff from agricultural areas of various sizes; influence of land use on infiltration. Before Am. Soc. Agric. Engrs.

EARTHQUAKES, GOLD COAST, AFRICA. Engineering Aspects of Accra Earthquake, C. S. Deakin. *Gold Coast—Geol. Survey—Bul. No. 13*, 1941, pp. 58–67, supp. plates, maps in pocket. Failures in buildings, water tanks, and water pipes reported; design of structures to resist earthquake shocks; design of reinforcement for single-story block building; seismic vibration of raw water tanks, Accra water works, Weija.

EARTHQUAKES, GOLD COAST, AFRICA. Geological Effects of Earthquake, D. A. Bates. *Gold Coast—Geol. Survey—Bul. No. 13*, 1941, pp. 18–41. Geological effects of earthquake were practically limited to area between Accra, Weija, and Fete, and to vicinity of Nakwa. Five types of phenomena were noted as follows: Fissures in alluvium and smaller cracks in Akwapimian rocks and made-up ground; vents from which sand, mud, or water were expelled; rock fails; disturbance of sea, lagoons, and rivers, and changes in level of surface of ground.

LOUISIANA. Summary of Hydrologic Data, Bayou Duplantier Watershed, 1933, 1939, G. N. Cox. *La. State Univ.—Eng. Experiment Station—Bul., No. 5*, vol. 32, no. 7, July 1940, 37 pp. Summary of continuous records of precipitation, runoff, and evaporation on drainage basin 0.8 sq miles in area, within city limits of Baton Rouge, La.

METEOROLOGY, CONNECTICUT. Weather and Climate of Connecticut, J. M. Kirk. *Conn. State Geol. & Natural History Survey—Bul., No. 61*, 1939, 242 pp., tables, diagrs. Study of climate of state of Connecticut including some long records of temperature, rainfall, snowfall, humidity, and floods.

RESERVOIRS, SILT. Reservoir Silting, C. B. Brown. *Water Works & Sewerage*, vol. 88, no. 6, June 1941, pp. 257–263. Report on studies of reservoir silting by U.S. Soil Conservation Service; survey procedures; reservoir cleaning; sluice gate flushing; records of annual rates of silting in water supply reservoirs; feasible approaches to silting control; relation of original storage per square mile of drainage area to average annual depletion of storage in Eastern states; relationship of depth to temperature and sediment concentration. Bibliography.

RUNOFF, MEASUREMENTS. Equipment for Runoff Measurements, A. L. Kennedy. *Agric. Eng.*, vol. 22, no. 6, June 1941, pp. 218 and 220. Bill of equipment and materials required for measurement of runoff from $^1/_{20}$ to $^1/_5$-acre plots for determining effect of fertilization and associated farm practices on erosivity and infiltration capacity of soils.

WIND POWER. World's Largest Wind-Turbine Plant Nears Completion. *Power*, vol. 86, no. 6, June 1941, pp. 56–59. Installation of 1,000-kw aero-electric plant and wind power research laboratory on top of 2,000-ft mountain near Rutland, Vt.; entire plant is built on heavy structural steel pintle girder on top of 100-ft tower anchored into mountain top by heavy steel and concrete foundation; discussion of wind turbine construction, electric generator, and anemometer installation.

INDUSTRIAL BUILDINGS

AIRPORTS, WASHINGTON, D.C. Construction of Terminal Building—Washington National Airport. W. E. Reynolds. *Am. Concrete Inst.—J.*, vol. 12, no. 6, June 1941, pp. 633–640. Details of concrete mix and form work used in construction of Washington National Airport three-story terminal building, 540 ft long and 90 ft wide, with center portion and one end having radius of 412 ft.

IRRIGATION

CANALS, REGULATION. Automatic Gate Control, I. H. Teilman. *Eng. News-Rec.*, vol. 126, no. 25, June 19, 1941, pp. 971–972. Description of automatic electric control mechanism used on canal inlet gate to regulate flow level.

LAND RECLAMATION AND DRAINAGE

WATERSHEDS, DRAINAGE. Graph for Talbot's Formula, B. Turner. *Eng. News-Rec.*, vol. 126, no. 25, June 19, 1941, p. 971. Presentation of logarithmic charts giving area of opening by Talbot's formula for watersheds of from 1 to 10,000 acres in flat, rolling, hilly, and mountainous country.

MATERIALS TESTING

CONCRETE REINFORCEMENT, BONDS. Bond Between Concrete and Steel, H. J. Gilkey, S. J. Chamberlin, and R. W. Beal. *Iowa State College Agric. & Mechanic Arts.—Eng. Experiment Station—Bul., 147*, vol. 39, no. 29, Dec. 18, 1940, 120 pp. Results of investigations of debatable aspects of bond; effect of length of bar embedment, strength of concrete, orientation at casting for different cements, and type of bar; slip of bar; strains in concrete at surfaces of both pullout specimens and beams; effect of rust, smoothness of bar surface, grease on bar, diameter of bar, type of curing, etc.

PORTS AND MARITIME STRUCTURES

LIVERPOOL. Port of Liverpool, J. N. Benson. *Dock & Harbour Authority*, vol. 21, nos. 244 and 245, Feb. 1941, pp. 80–82, and Mar., pp. 103–106. History of development of port of Liverpool, England, since Middle Ages; recent developments. Before Bromborough Soc.

SHORE PROTECTION. General Question of Coast Erosion and Measures Desirable for Prevention of Damage Caused Thereby; and Drainage of Low-Lying Lands, T. B. Keay. *Instn. Mun. & County Engrs.—J.*, vol. 67, no. 6, Nov. 5, 1940, pp. 129–145. Discussion of processes of coast erosion; sub-aerial erosion; marine erosion; supply and distribution of beach material; measures desirable for prevention of damage; erosion vs. accretion; revetments and stockades; groynes; cliff protection; drainage of low-lying lands; drainage methods between barrier banks; drainage law.

ROADS AND STREETS

AIRPORTS, WASHINGTON, D.C. Washington National Airport, R. S. Thomas. *Asphalt Inst.—Construction Series*, no. 54, 1941, 28 pp., supp. maps. Description of airport, intended as model in design of commercial airports; notes on location and setting, design, hydraulic fill and grading, paving, asphalt for runways, and buildings and grounds. Before 13th Nat. Asphalt Conference.

CONCRETE. Construction of Concrete Roads, B. L. Wright. *Roads & Road Construction*, vol. 19, no. 221, May 1, 1941, pp. 80–82. Description of English practice in concrete road construction, with special reference to subgrade treatment and drainage. Before Instn. Highway Engrs.

CONSTRUCTION. Accessible Two-Piece Keyway Simplifies Tiebar Installation in Concrete Pavement. *Construction Methods*, vol. 23, no. 6, June 1941, pp. 95–96. Description of longitudinal keyway made up of two members—bottom member bolted to form and top cover member installed after bent dowel bars have been placed, facilitating insertion of tiebars and permitting stripping of keyway without bending of bars.

CONSTRUCTION. Muck Dredged Out, Solid Fill Pumped, T. E. Wilson. *Roads & Streets*, vol. 84, no. 6, June 1941, pp. 33–36. Report on construction of recently completed road across marsh lands of Beaufort County, South Carolina, where 20 to 30 ft of unstable mucky material had to be dredged out before road fill could be built to elevation of $8^1/_2$ ft above marsh; surveying problems; probing through marsh to locate elevation of sand bottom; procedures during construction; handling shovel waste; pumping around piling; efficiency of flat slopes.

HIGHWAY SYSTEMS, CANADA. Trans-Canada Highway, E. L. Chicanot. *Compressed Air Mag.*, vol. 46, no. 4, Apr. 1941, pp. 6400–6403. General features of plan and construction of trans-Canada highway from Halifax to Vancouver, described in several previously indexed articles.

HIGHWAY SYSTEMS, PORTUGAL. A estrada marginal e a auto-estrada, P. de Serpa Pinto Marques. *Ordem dos Engenheiros—Boletim*, vol. 4, no. 48, Dec. 1940, pp. 507–542. Marginal highway and automobile highway; fundamental factors of South Coast network; considerations on evolution of vehicles and of communication highways; South Coast network; marginal highway, following coast line; design features; auxiliary works; viaducts and bridges.

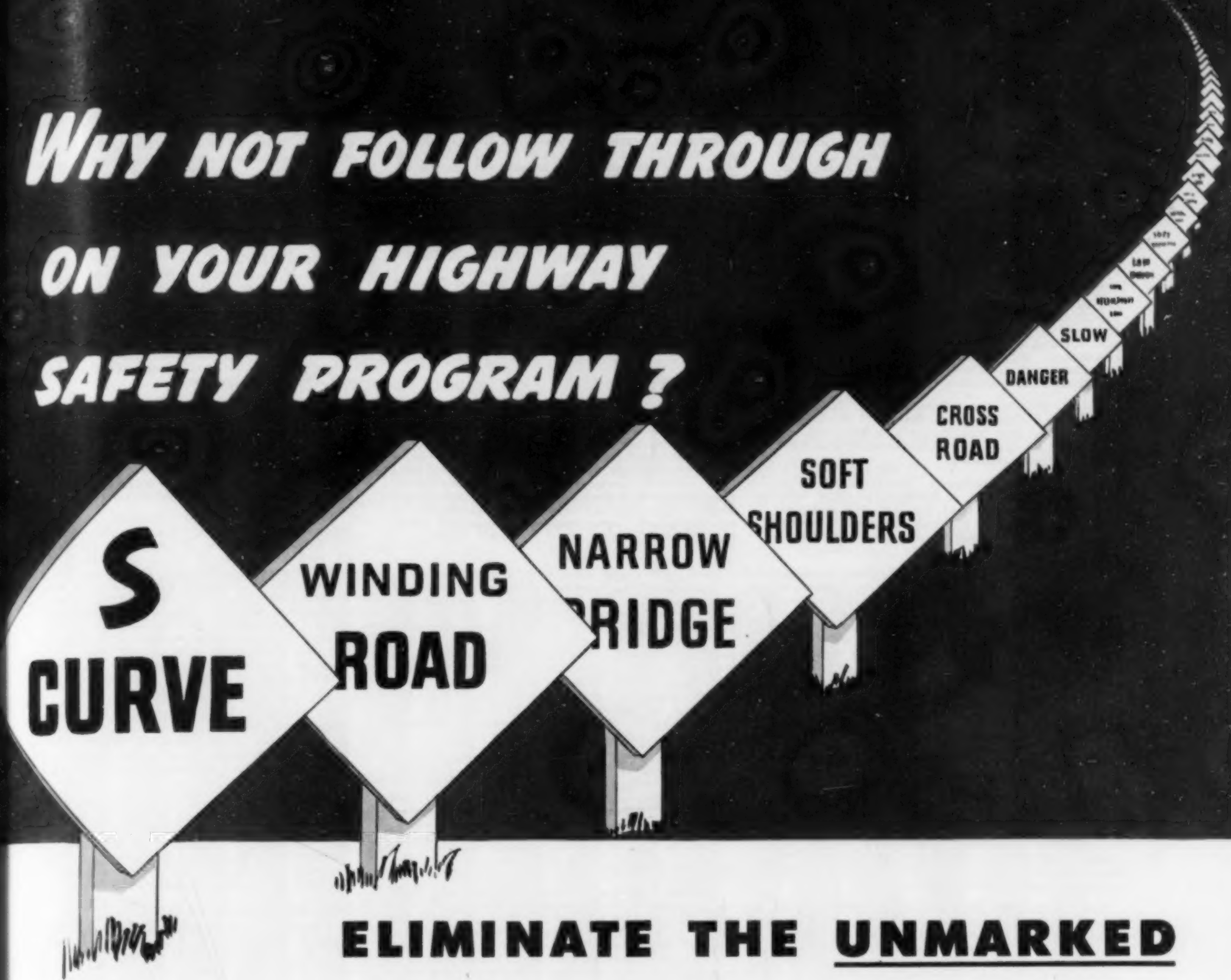
MAINTENANCE AND REPAIR. Reducing Road Maintenance, H. H. Sisler. *Western Construction News*, vol. 16, no. 6, June 1941, pp. 161–163. Review of practice developed by King County, Wash., for reducing highway maintenance costs by surfacing county roads in three-stage bituminous construction plan; dust problem; cost of program.

MILITARY, PAVEMENTS. Army Camp Paving at Fort Ord Includes Light- and Heavy-Duty Bituminous Types. *Construction Methods*, vol. 23, no. 6, June 1941, pp. 62–63, 113–114, and 117. Methods and equipment used in placing more than 400,000 sq. yd. of asphalt penetration macadam, 3 in. thick, in main streets and truck parking areas at Fort Ord, Calif.

RAILROAD TRANSPORTATION, WAR TIME. British Road and Rail Experience in War, L. V. Murrow. *Eng. News-Rec.*, vol. 126, no. 25, June 19, 1941, pp. 944–945. Summary of report to U.S. Pub. Roads Administration on highway and railway transportation in England under war conditions; effect of aerial bombardments; wartime traffic problems; organizing highway transport.

RELOCATION. Bridges Take Place of High Embankments, R. L. Iddins. *Roads & Streets*, vol. 84, no. 6, June 1941, pp. 49–50. Report on relocation of U.S. 19E, in east Tennessee where it was found cheaper to build deck truss and deck girder bridge at two main river crossings than it

WHY NOT FOLLOW THROUGH ON YOUR HIGHWAY SAFETY PROGRAM ?



ELIMINATE THE UNMARKED HIGHWAY HAZARDS TOO...

● There are always some motorists who do not believe the signs. That's why your highway safety program includes the elimination of obvious driving hazards by highway straightening and widening and building long radius curves. But what do you plan to do about the unmarked hazards—patched areas over cracked and broken pavement, that have not been properly treated to make them skid-proof—traffic-worn surfaces of all kinds that have lost their skid-resistance?

Plan now to include skid-proofing in your safety program. Find out how easy it is to eliminate most of these hazards with Asphalt-aggregate treatment.

On some traffic-worn surfaces only a light coat of Asphalt and the right aggregate will provide a safe, tire-gripping surface. Cracked and broken pavement may be properly patched or completely resurfaced with Asphalt to restore the smooth, anti-skid riding surface.

The Standard Oil Asphalt representative in your locality will be glad to consult with you on the methods and materials for your particular conditions. Write Standard Oil Company (Indiana), 910 So. Michigan Ave., Chicago, Ill., for the representative nearest you.

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was to build embankments to grade with waterway structures.

ROAD MACHINERY, STANDARDS. Writing Specifications for Equipment Purchase by Bids, W. A. Keith. *Western Construction News*, vol. 16, no. 6, June 1941, pp. 164–165. Review of changes in Los Angeles County Road Department specifications, eliminating use of controversial phrase "or equal" in advertising for purchase of highway equipment; specifications for new current model 8-ton tandem roller, 1/2-ton pick-up truck, and for new current model motor grader.

ROAD MATERIALS, BITUMINOUS. British Standard Methods for Sampling and Examination of Bituminous Road Mixtures. *Brit. Standards Inst.—Brit. Standard Method No. 598*—1940, 41 pp. Definitions; sampling; methods of examination; suggested form of certificate of routine analysis of bituminous road mixtures; method for rapid determination of soluble bitumen.

ROAD MATERIALS, BITUMINOUS. Non-Skid Surfaces for Roads, E. J. Hamlin. *S. African Engr. & Elec. Rev.*, vol. 32, no. 275, Mar. 1941, p. 21. Methods of dealing with old roads that have already become polished.

ROADSIDE IMPROVEMENT, BILLBOARDS. Winning Billboard War, A. S. Bard. *Nat. Mun. Rev.*, vol. 30, no. 7, July 1941, pp. 409–411 and 460. Citizen groups work for highway zoning legislation; restrictions to billboards already on statute books in 22 states.

SOILS, TESTING. Report on Current Methods of Soil Testing, and Other Matters Connected with German Road Construction, R. Young. *Instn. Mun. & County Engrs.—J.*, vol. 67, no. 9, Feb. 4, 1941, pp. 201–210. Review of soil-testing procedure adopted by German engineers in construction of superhighway system of Germany.

SEWERAGE AND SEWAGE DISPOSAL

ACTIVATED SLUDGE. Operating Fundamentals of Activated Sludge Process, T. R. Haseltine. *Water Works & Sewerage*, vol. 88, no. 6, June 1941, pp. 274–279. Oxidizing power of activated sludge; effect of sludge density on volumetric sludge-settling test; causes of oxidation lag; sewage input vs. air input; measuring sludge in mixed liquor; centrifuge test; tapered aeration vs. delayed loadings; importance of prompt sludge recirculation; effect of sludge index values on suspended solids tests with centrifuge; sludge concentration. Bibliography.

CHLORINATION. Perplexing Chlorination Problem, J. H. LeChard and G. W. Denbury. *Water Works & Sewerage*, vol. 88, no. 6, June 1941, pp. 281–284. Design and construction of liquid chlorine pipe lines, 1,600 ft long, carried on foot-bridge to City Island treatment plant for chlorination of sewage of Atlantic City, N. J.; considerations in designing liquid chlorine line; thermal expansion protection; liquid chlorine expansion; calculations of required volume of expansion tank; chlorine escape protection; stop-flow safety valve.

DISPOSAL PLANTS, CANADA. Sewage-Disposal Plants. *Water & Sewage*, vol. 79, no. 4, Apr. 1941, 3 pp. between pp. 26–30. Tabulated statistical data on sewage disposal plants of Canada, arranged by provinces, including population served, designed capacity, method of sludge treatment and disposal, etc.

INDUSTRIAL WASTE. Recent Contributions to Study of Industrial Waste Treatment, D. H. Barraclough. *Surveyor*, vol. 99, no. 2561, Feb. 21, 1941, pp. 147–149. Review of recent American and British studies of treatment of acidic, metallic, canning, textile, tannery, dairy, sulfite, and phenolic wastes. Bibliography. Before Inst. Sewage Purification.

REFUSE DISPOSAL, WASTE UTILIZATION. Municipal Manufacture of Humus from Habitation Wastes, F. C. Temple. *Surveyor*, vol. 99, no. 2560, Feb. 14, 1941, pp. 125–126, (discussion) 126–127. Discussion of municipal manufacture of organic fertilizers from composts of sewage and house refuse; difficulties in development of waste disposal; use of wastes as fertilizers; cost of conversion.

SASKATCHEWAN. Sanitation in Province of Saskatchewan, J. G. Schaeffer. *Water & Sewage*, vol. 79, no. 5, May 1941, pp. 11–14 and 42–45. Review of public health history in Saskatchewan; protection of public water supplies; water-works systems in Saskatchewan; subsurface waters; sewerage systems in Saskatchewan; typical sewage-treatment plants; airport sanitation; typhoid fever control.

SEWAGE ANALYSIS. Preservation of Sewage Samples, G. E. Phillips and W. D. Hatfield. *Water Works & Sewerage*, vol. 88, no. 6, June 1941, pp. 285–288. Experience of Decatur Sanitary District, Decatur, Ill., with automatic proportional sampling; study of storage temperatures; progressive changes in B.O.D. and suspended solids of samples of sewage, effluent, and industrial waste on standing; storage drop in B.O.D.

STRUCTURAL ENGINEERING

ARCHES, CONCRETE. Stress Distribution in Reinforced Concrete Arches, R. H. Evans. *Engineer*, vol. 171, no. 4452, May 9, 1941, pp. 301–303. Results of experiments carried out on three-hinged, two-hinged, and hingeless arches, with particular reference to longitudinal and shear stresses and to crown deflections.

ROOF TRUSSES. Long-Span Timber Trusses Prefabricated and Shipped by Rail, Support 8-Acre Roof for Aircraft Plant. *Construction Methods*, vol.; 23, no. 6, June 1941, pp. 64 and 102–103. Features of timber trusses of Douglas fir, ranging in clear span up to 140 ft, prefabricated in Portland, Ore., knocked down, and shipped by rail to Wichita, Kans., distance of more than 1,500 miles; enlargement of plant of Beech Aircraft Corp.

SURVEYING

RESERVOIRS. Mapping Lake Mead, C. B. Brown. *Geographical Rev.*, vol. 31, no. 3, July 1941, pp. 385–405. Methods and equipment used in surveying and mapping of Lake Mead reservoir of Boulder Canyon Project, featuring use of aerial photography; horizonal and vertical control; channel survey from dam to Pierces Ferry; measurements of backwater slopes; cartographic work; engraving and printing; measurement of contour areas; computation of capacity; problem of sedimentation.

TUNNELS

CONSTRUCTION, LINING. Modern Methods of Tunnel Lining, R. Hammond. *Engineering*, vol. 151, no. 3931, May 16, 1941, pp. 381–383. Illustrated description of different successful methods, including use of structural steel and pre-cast concrete segments; results of tests carried out to compare relative strengths of cast-iron lining and pre-cast concrete lining; McAlpine system of reinforced concrete lining; description of self-supporting cavity lining developed by B. H. Colquhoun and T. Whitley Moran.

WATER SUPPLY, NEW MEXICO. Conchas Canal Tunnel Record, C. B. Stetson. *Western Construction News*, vol. 16, no. 6, June 1941, pp. 173–175. Methods and equipment used in construction of 11.5-diameter concrete-lined tunnel on Tucumcari project, near Conchas Dam in New Mexico, at record speed of 71 ft in three shifts.

WATER PIPE LINES

WATER HAMMER. Druckwindkessel und Kreiselpumpen, W. L. Boerendans. *Gas- u. Wasserfach*, vol. 83, nos. 48 and 50, Nov. 30, 1940, pp. 605–611, and Dec. 14, pp. 659–663. Mathematical discussion and analysis of effect of compressed air chambers on pressure fluctuations in water distribution systems comprising centrifugal pumps, assuming that water in pipes is either slightly elastic or entirely inelastic; conditions favoring use of air chambers.

WATER RESOURCES

UNDERGROUND, GREAT BRITAIN. Outlines of Underground Water Supply in England and Wales, F. H. Edmunds. *Water & Water Eng.*, vol. 43, no. 541, Midsummer 1941, pp. 185–213. Abstract of paper before Instn. of Water Engrs., presenting studies of hydrology of underground water supply of England and Wales; water table and rest level; springs and swallow holes; influence of geology on underground water circulation and storage; geographical distribution and description of water-yielding strata in England and Wales; drift deposits in relation to underground water.

WATER TREATMENT

COAGULATION. Magno-Eisensol, ein neues Faellmittel zur Wasserreinigung, H. Boerner. *Gas- u. Wasserfach*, vol. 83, no. 47, Nov. 23, 1940, pp. 589–592. Study of properties of magno-ferric sol, with special reference to its use as coagulating agent in water treatment for floating of humus and iron compounds.

COAGULATION. Paddle Wheel Stirring, R. D. Nichols. *Water Works & Sewerage*, vol. 88, no. 7, July 1941, pp. 323–325. Discussion of use of paddle wheels in rapid-mix coagulation and flocculation; functions of paddle wheel; experiments and tests; paddle wheel design; paddle wheel construction in actual installations. Bibliography.

FILTRATION PLANTS, ALLENTOWN, PA. Filter Washing, H. J. Krum and I. M. Glace. *Water Works & Sewerage*, vol. 88, no. 5, May 1941, pp. 189–195. Discussion of results of old and new methods of filter washing, with special reference to experience at 10-mgd water filtration plant at Allentown, Pa.; high wash rates; sand coating and mud ball data showing reductions in quantities after installation of surface wash; filter run and wash records; records of chlorine removal by filters; costs of installation. Bibliography.

FILTRATION PLANTS, CANADA. Current Trends in Water Filtration Practice in Canada, A. E. Berry. *Water & Sewage*, vol. 79, no. 4, Apr. 1941, pp. 7–16. Review of equipment and methods of modern water filtration plants in Canada; kinds of filters; pressure filters of early period; equipment for pressure filters; modern gravity filters; preparation of water for filtration; coagulate mixing; mechanical mixing tanks; coagulation tanks; capacities of filter beds; anthracite as filter medium; rate control equipment; laboratory facilities; cost of water filtration plants.

WATER BACTERIOLOGY. Isolation of Coliform Group, N. J. Howard. *Water Works Eng.*, vol. 94, no. 13, June 18, 1941, pp. 694–697. Review of development of present-day methods for isolation of coliform group of bacteria in water since 1890; desirability of buffered media; introduction of brilliant green bile broth; evaluation of media; Canada studies of brilliant green bile; Dominick-Lauther broth; classification of tests; experience with epidemic.

WATER FILTRATION PLANTS, OPERATION. Auffuellung von Langsam-Sandfiltern durch Einspuelen von Filterkies, W. Duhnsen. *Gas- u. Wasserfach*, vol. 83, no. 42, Oct. 19, 1940, pp. 527–530. Description of new methods of replenishment of slow sand filters by pumping sand and gravel into them, resulting in great reduction of costs and labor; itemized cost data.

WATER FILTRATION PLANTS, OPERATION. Experiences at World's Largest Filter Plant, J. E. Kerslake. *Water Works Eng.*, vol. 94, nos. 13 and 14, June 18, 1941, pp. 748, 751–752, 755–756 and 765–766, and July 2, pp. 838–840. Description of 200-mgd water filtration plant of Milwaukee, Wis., and its operating routine, application of chemicals; corrections made at plant; automatic valves; wooden baffles in mixing basins; improvement of feed control; chlorine residual; tests made with carbon; alum vs. ferric sulfate; chemicals used in 1940; average doses of chemicals; maintenance cost.

WATER SOFTENING. Chemical Aspects of Hardness in Water and Its Removal, T. Stones. *Water & Water Eng.*, vol. 43, no. 540, June 1941, pp. 160–162. Discussion of nature of water hardness and chemistry of water softening; lime and soda process; advantages and disadvantages of zeolite process.

WATER SOFTENING. Lime Needed for Removing Hardness from Water, G. E. Hands. *Water Works Eng.*, vol. 94, no. 13, June 18, 1941, pp. 779–780. Presentation of graphical charts simplifying calculation of amount of lime to soften given quantity of water; variation from theoretical results; numerical examples.

WATER WORKS ENGINEERING

CANADA. Water Works Statistics. *Water & Sewage*, vol. 79, no. 4, Apr. 1941, 49 pp. between pp. 34–112. Condensed information on principal water works of Canada, including sources of supply, pumps, purification, distribution, services, meters, officials, population, and other reference data, omitting municipalities under 500 population.

COLORADO RIVER AQUEDUCT. Colorado River Aqueduct Goes to Work, D. J. Kinsey. *Water Works Eng.*, vol. 94, no. 13, June 18, 1941, pp. 705–708, 712, and 763–764. Review of development of Colorado River water supply system in Southern California; financial basis on which member cities participate; rules for purchase of water.

ITALY. Der neue Kaiserliche Aquaedukt und das grosse Wasserkraftwerk fuer Rom, G. Tian. *Gas- u. Wasserfach*, vol. 83, no. 49, Dec. 7, 1940, pp. 634–641. Description of new combined water supply and hydroelectric power development for delivery of about 4 cu m per sec of drinking water and annual production of 64,000,000 kw hr for city of Rome, Italy, deriving from Velino springs about 90 km northeast of Rome; details of concrete line aqueduct and of power plant; construction progress.

MADISON, WIS. Deep Wells in Sandstone Rock, L. A. Smith. *Water Works Eng.*, vol. 94, no. 13, June 18, 1941, pp. 710–712. Review of practice of water department of Madison, Wis., in development of deep large-capacity water wells; sealing of wells with concrete plugs; shooting of water formations with explosives.

NATIONAL DEFENSE. Waterworks Preparedness. *Eng. News-Rec.*, vol. 126, no. 25, June 19, 1941, pp. 953–970. Symposium on operation of water works as part of National Defense Program, including following: Preparedness Headquarters, H. Jordan; Industry Is Mobilized, K. M. Mann; War and Water Service, N. J. Howard; Trouble Shooters at Work, J. S. Longwell; Sentinels of Service, P. Lippert; Pooling Water Resources, C. H. Capen; Clean Mains and More Capacity, C. Inglee; Main Sterilization, H. N. Armbrust; Distribution System Diagnosis, E. K. Wilson; Water for Fire Fighters.

SPRINGFIELD, MO. New Waterworks of Springfield, Mo., L. R. Howson. *Water Works & Sewerage*, vol. 88, no. 6, June 1941, pp. 241–247. History of water works of Springfield, Mo., and description of new 12-mgd water treatment plant, including steam turbine pumping station; operating routine.

Equipment, Materials, and Methods

New Developments of Interest, as Reported by Manufacturers

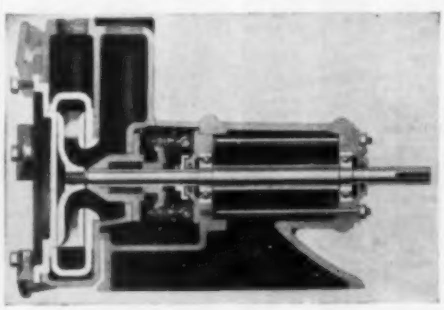
Dixon's Phano Pencils

PURPLE AND GREEN are now available in the Phano line of pencils, manufactured by the Joseph Dixon Crucible Company, which brings the range of colors to ten. Phano pencils are used largely for marking highly polished metal, glass and other glazed surfaces, and are specially designed to leave a clear, durable mark on polished surfaces without danger of scratching or scoring.

There is a broad field of application for Phano in industry, where it is necessary to mark metal parts for identification or where instructions must be written on the part without danger of damaging the piece through abrasive action. The range of ten colors enables parts to be marked for positive and instant identification and also permits the layout of work directly on the metal, since markings made with it will not wash off when the metal is sprayed during the cutting. The Phano line now includes red, yellow, black, vermilion, blue, white, purple, green, light green, and Pyro-red (brown).

Horizontal Shaft Pump

ROUNDING OUT THEIR NEW LINE of industrial pumps, the American Manganese Steel Division of The American Brake Shoe & Foundry Co., Chicago Heights, Ill., is now in production on Amsco-Nagle Horizontal Shaft Pumps.



Designated Types "A" and "T," these pumps are available in all sizes from 3/4 in. to 6 in. in capacities up to 1,400 gal per min and for operating heads up to 100 ft. A variety of materials is used in the construction of these pumps, the choice depending upon the extent of the abrasion or corrosion under which a pump is to operate. Both types feature clamp-bolt construction of the water end, a bearing arrangement that assures proper alignment, sealed bearings, a readily accessible stuffing box and self-priming. Four types of impellers are available.

These pumps are recommended for handling sludge, slime, and slurries. Complete details in Bulletin No. 940 will be sent by the manufacturer.

Paving Breaker

INGERSOLL-RAND COMPANY announces a new 60-lb class "cushioned-air" paving breaker known as the CC-60. It is reported that this tool is ideal for hard clay, shale, brick, concrete, or for jobs where it is not feasible to use a heavier tool. The ease in handling this tool comes from an air cushion which absorbs the blow of the piston when the steel is not in contact with the work. Consequently, there is far less fatigue for the operator and less breakage of parts. Although developed as a lightweight, easy-handling tool, the CC-60 because of its hard hitting blow makes a fine machine for all-around paving breaker work. A new booklet, Form 2768 gives, all details, Ingersoll-Rand Company, 11 Broadway, New York, N.Y.

Aluminum Co. Increases Production and Lowers Prices

THE ALUMINUM COMPANY of America announces that negotiations have been completed and a contract made with Defense Plant Corporation acting for the United States for the construction and operation of an alumina plant in the State of Arkansas with an annual capacity of 400,000,000 lb, and for the construction and operation of three aluminum smelting plants, one at Massena, N.Y., with an annual capacity of 150,000,000 lb, another in the Portland-Oregon district with an annual capacity of 90,000,000 lb, and a third in Arkansas with an annual capacity of 100,000,000 lb. The production of approximately 340,000,000 lb per year from the plants covered by the contract with the Defense Plant Corporation when added to the production of the Aluminum Company's own plants of approximately 760,000,000 lb per year will give the Aluminum Company an output of approximately 1,100,000,000 lb per year.

The Aluminum Company also announces that the price of ingot aluminum will be reduced from 17 cents to 15 cents per pound on shipments made after September 30, 1941, and that reductions will be made in the price for fabricated aluminum in conformity to the ingot price reduction. The present reduction in price is made in anticipation of the economies from the building of the new plants.

New White Tracing Cloth

GOOD, CLEAR BLUEPRINTS are made from pencil tracings on The Frederick Post Co.'s new white tracing cloth, Whitex, according to the manufacturer's reports.

It is stated that every pencil mark or line on Post's No. 123 Whitex is dense and sharp—its special processed velvety surface takes black and colored pencils perfectly. It is tough, durable, and will not discolor with age. Its glossy "stay clean" back is an added feature and its extra transparency adds speed to print production. Whitex also erases quickly and cleanly with art gum or a soft eraser and erasures do not show on the blueprint.

Samples will be sent by Frederick Post Company, Box 803, Chicago, Ill.

Arm-Type Hoist Models

GAR WOOD INDUSTRIES, INC., Detroit, Mich., is now in production of several new arm-type hydraulic hoist models which are recommended for installation on $1^1/_2$ to 2-ton truck chassis and for use on dump bodies from 8 to 10 ft in length.

These hoists are being manufactured in three sizes, D6R, D7R, and D7LR, and are said to incorporate such features as a new and exclusive type of lifting arrangement; minimum stress on body and hinges; minimum stress on truck chassis frame; longer lever arm; fewer working parts; faster operation; minimum oil pressure; low mounting (when specified); and minimum weight for an arm-type hoist. Details are given in Bulletin No. 29.

New Wilson Transformer Welders

A NEW LINE OF A.C. Transformer Welders in 300, 500, 750, and 1,000-ampere capacities has just been announced by Wilson Welder and Metals Company, Inc., 60 East 42nd St., New York, N.Y. Known as Model TW, these welders are completely self-contained units, for 220, 440, or 550 volts, 25 or 60-cycle current, that will meet the heavy arc welding needs of shipyards, railroads, and steel mills. When arranged for 220 and 440-volt operation, single phase, either voltage can be brought into use by a reconnection of the leads which are brought outside the unit.

The new welders have a wide range of current output and continuous stepless current regulation is provided over the entire range by means of a hand crank on top of the machine. This crank makes it possible to rapidly shift the setting as changes are made from one class of work to another. The Model TW conforms to N.E.M.A. requirements, and is said to operate cooler and therefore last longer, because of divided construction of the coils which allows greater surface area to be exposed to the cooling air. All coil covering is spun glass fiber, heat-resistant, Class BB insulation, providing trouble-free operation even if used continuously at maximum settings.

On 60-cycle units, all sizes are fan-cooled except the 300-ampere size, which is cooled by natural draft. On 25-cycle units, all sizes are fan cooled. The 60-cycle units have high and low range switches, while the 25-cycle units have only one range. This low range switch provides current adjustments on the 500-ampere size from 40 to 650 amperes. Power factor correction is included in all models for 60-cycle operation except the 300-ampere size. Welders built for 25-cycle operation do not have power factor corrected. Efficiency of all the TW units is approximately 80 to 85%. Further information or descriptive literature may be obtained from the Wilson Welder and Metals Company, Inc., 60 East 42nd St., New York, N.Y.

Time Saver for Arc Welding

THE ARC WELDERULE is being offered for the use of engineers, supervisors, purchasing agents, operators, and all others who use or supervise the use of arc welding electrodes, by the General Electric Company, Schenectady, N.Y.

Operating in a manner similar to a slide rule, the Arc Welderule reads directly the length of arc welded joints obtainable per 100 lb of electrode, also the pounds of weld metal deposited per 100 lb of electrode. The information covers eleven different commonly used sizes and types of joints; also twenty-two different sizes and types of popular electrodes in both the 14- and 18-in. lengths. Being of vest-pocket size, it is convenient to use in getting the answer quickly, and enables accurate estimates to be made because it applies to specific types and sizes of electrodes.

An additional feature of this new Arc Welderule is a selector chart which shows the various filler metal classifications as specified by the American Welding Society, and the types of electrodes which meet these classifications.

Electronic Level Control

PHOTOSWITCH LEVEL CONTROL provides on and off valve or pump control of any liquid. Photoswitch probes or electrodes are attached to the tank at levels representing the low point where pumping starts and the high level where pumping stops. These probes are wired to Photoswitch Level Control. When the liquid level falls below the lower probe, the Level Control starts the pump in operation; when the level rises to the upper probe, the fluid itself acts as a conductor of the small amount of current required for the operation of Level Control which stops the pump. Even when used with non-conductive fluids, the probe circuit carries only milliamperes of current and low voltage.

Complete equipment is available for single level indication and control, on and off pump-up and pump-down control at two levels, boiler feedwater control, and low level safeguards. Probe fittings have been designed for high and low pressure and temperature requirements as well as for sanitary installations. Pamphlet 1100 describes Photoswitch Level Control Series P 16 and will be forwarded upon request. Photoswitch Inc., 21 Chestnut St., Cambridge, Mass.

Right: A few of a large number of Limitorque Controls installed in the filtration plant of a New England city.

In water works and sewage disposal plant service, where operating conditions are occasionally bad, Limitorque Valve Controls are constantly adding new laurels to their record for dependability. Regardless of conditions, when you push the control buttons . . . Limitorque functions properly. Install Limitorque for operating sluice gates and all makes of valves up to 96″ diameter. They're adaptable to existing equipment. Floorstand controls available for use where direct mounting is not advisable. Write now for complete details.

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Literature Available

EXCAVATORS—Low-cost ways of stepping up irrigation profits are outlined by Bucyrus-Erie Co., South Milwaukee, Wis., in their illustrated folder, "Put Lazy Water to Work."

JACKS—Buda Co., Harvey, Ill., has issued a new pocket catalog, bulletin No. 1066, which contains complete factual data of all types and sizes of Buda jacks.

LAND CLEARING—A new booklet, 12 pages in two colors, featuring several important land clearing projects, has just been released by the LaPlant-Choate Mfg. Co., Inc., Cedar Rapids, Iowa.

MOTORS—Allis-Chalmers Mfg. Co., Milwaukee, Wis., has issued an eight-page bulletin (B6052-B) describing the complete line of Lo-Maintenance Motors in ratings from $^3/_4$ to 75 hp, open, enclosed, and splash-proof types, a-c and d-c.

OZONE—A Report on Ozonation at Whiting, Ind., is published by Ozone Processes, Inc., 1500 Walnut St., Philadelphia, Penna.

PUMPS—Three new centrifugal pump catalogs on Sewage and Waste Disposal, Close Coupled Centrifugals, and Type BA have been issued by Gardner-Denver Company, Quincy, Ill.

SHOVEL PARTS—Two new bulletins have recently been issued by the American Manganese Steel Div. of The American Brake Shoe & Foundry Co., Chicago Heights, Ill. Bulletin No. 641-D describes Ansco Dippers and parts; Bulletin No. 641-S gives details on power shovel and dragline parts.

SPECIAL SERVICE SPRINGS—A new booklet which reports in detail on the value of "Z" Nickel and "K" Monel, and Monel, Inconel, and malleable nickel for spring purposes under conditions which involve exposure to corrosion as well as to high and low temperatures and other severe service has been published by The International Nickel Company, New York, N.Y. Included are technical data and tables on strength, stiffness, endurance, resistance to corrosion and corrosion fatigue, effects of high temperatures, and magnetic and electrical properties.

VERTICAL PUMPS—The increased efficiency obtained in the performance of Pomona Pumps through their "bulbous vane end shape" is described in a new folder. Pomona Pump Co., Pomona, Calif.

WELDED ERECTION SYSTEM—A manual of recommended practice for the use of Saxe Seats and Clips in welded structural steel erection—42 pages, $8^1/_2$ by 11 in. J. H. Williams & Co., 400 Vulcan St., Buffalo, N.Y.

WIRE ROPE HANDBOOK—The new wire rope Catalog-Handbook of 170 pages, G-14, just issued by Macwhyte Wire Rope Company, Kenosha, Wis., lists more than 1,000 ropes, and is sectionalized for quick reference with a tabbed index and table of contents for each section.